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EDITORIALS

STUDYING COURT DECISIONS.

Legal documents usually possess little interest for the engineer, or in fact for any one except the lawyer and the persons directly affected by them. Court proceedings, unless of a sensational character, are usually shunned for a similar reason. Reports of decisions are looked upon as the dryest kind of reading that could possibly be selected. A little investigation, however, might dispel this attitude. The decisions of the higher courts are usually concerned with questions and cases of considerable importance. They frequently contain not only stories of human interest, but discussions of engineering subjects and analyses of conditions, facts and points of law of vital importance to the engineer, the contractor, the central-station manager, or in fact any one connected with the electrical industry.

Patent cases of course involve many engineering points, but in addition to these there are accident cases, rate cases, and many others involving items of interest. Such can easily be picked out from a volume of reports, and many of them constitute interesting reading and well repay time spent upon them in the information and points of view which they disclose. The circumstances attending accidents are frequently instructive and may point the way to preventive measures which will make a repetition impossible. Moreover, the attitude of the court in placing responsibility is often illuminating. Defects in material, carelessness in operation, failure to provide safeguards or to follow specifications and many other contributory causes of accidents repeatedly come up for consideration, and many ideas may be gleaned which will be helpful in future practice.

Interesting sidelights are frequently thrown upon so-called expert testimony. Experts will frequently be found expressing contradictory opinions, and it is noticeable that some of the best authorities on a given subject are never called into court. Presumably this is because neither litigant considers a certain expert "safe"—he might disclose some truth which would be of benefit to the opposing side. Such conditions disclose the absurdity of having so-called witnesses retained by either party to a suit. Partisan experts should be recognized as advocates for one side or the other, and any expert assistance needed by judge or jury should be called in independently of the litigants. This would promote a greater measure of justice. If, in addition, the pay of such witnesses were limited to the ordinary witness fees, at least one incentive for hiding a part of the truth would be removed.

AN IMPORTANT ADVANCE IN TELEGRAPHY.

When one of the electrical arts has attained the hoary age of seventy years without a radical improvement in the original methods employed, one is prone to admit that the pioneers in that art succeeded in developing methods and apparatus as near perfection as the inherent nature of the media employed will permit. And yet an impartial survey of the history of the submarine cable, second of all electrical industries in amount of capital invested, proves again the truth of old axioms concerning ruts. For here again, as was the case with the long-sought telephone repeater, the radical improvement comes at last not from those engineers who made this their every-day work, but from an outsider, free from the hidebound traditions of the cable builders.

It should be to Americans a special source of satisfaction that although practically every improvement in cable methods, manufacture and operation has by common consent originated in Great Britain, the first genuinely radical improvement in cable signaling since the days of Cyrus Field, is the work of an officer of the United States Army Signal Corps.

Col. George O. Squier, our military attaché at London, has during the past two years developed a cable signaling system, transmitting and receiving, which possesses so many striking advantages, and offers such unquestionable improvements over all previous methods as to be certain of eventual general adoption. In a paper presented before The Physical Society of London, and abstracted in this issue, Colonel Squier describes his novel method of attacking the cable problem along lines of electrical power transmission. By substituting for the time-honored make-and-break battery-current transmitter a low-frequency single-phase sine-wave alternator, the current from which is never broken; and a single time element for the differing durations of dot, space, and dash, he achieves simplicities and economies which are truly astonishing.

Consider first the novel form of received record, a reproduction of a portion of an alphabet of which is given. The dot is a single stroke, the dash a triple stroke, but covering the same length of paper as the dot or the space. The ease with which this record is read is most striking. Here at once the Squier method does away with the need for specially trained, highly paid cable readers. The veriest novice can translate such tape with accuracy at present unknown over long cables. Again, the abolition of the siphon re-

corder permits the use of cheap paper tape, a trifling consideration until one realizes that the annual bill for siphon recording tape of the Eastern Cable Company alone amounts to thousands of pounds sterling. This novel alphabet, moreover, permits relaying directly from cable to land wires, or *vice versa,* for it is "universal"—can be employed equally well and with like economies for both.

By use of the sine wave at the transmitter a relatively much larger percentage of transmitted power is received at the distant station, so that we have now a margin of safe working in automatic relaying as well as in tape recording, which was impossible with the use of square-topped waves at the transmitter. Then, too, and for the same reason, the high voltages existent from the higher harmonics in the square-topped waves, which may under certain conditions endanger cable insulation, are done away with. With the unbroken, pure sine wave, higher average potentials can be safely employed with a correspondingly increased energy delivered at the receiver. Particularly would this advantage be applicable if the first 200 or 300 miles of a submarine cable were made of higher insulation than would be necessary for the deep-sea portions.

Undoubtedly the most important of all advantages achieved by the Squier method is the economy of time effected. As sample comparative records show, from 50 to 100 per cent more letters per minute can be transmitted than with the old methods and old alphabet. With the make-and-break methods, the transmitting end of the cable must be connected to earth after each signal, to clear out the excess charge which was thereby unavoidably put in. In other words, at present the entire cable plant is idle for 25 per cent of the time, a plant representing a cost approximating $2,500,000 shut down, so to speak, for sweeping-out purposes, six hours a day.

Major O'Meara, in a paper on the new Squier method, read before the Royal Engineers Society of London, states that two transatlantic cables can now do the work of three, representing a saving in initial cost of plant of over $2,500,000, to say nothing of savings in operation of the third cable.

But these economies are figured on a basis of alternating current of 4 to 10 cycles per second. There is no reason why with higher sine-wave voltages (or even with present voltages and amplifiers at the receiving end) frequencies at least as high as 50 per second may not be used. This would correspondingly multiply the signal speeds permissible by the Squier method of transmitting.

Now as to long land lines, where Wheatstone or other rapid transmission methods are employed, we need in this field the same revolutionary change. Telegraph engineers, no less than cable men, have labored consistently in the rut of square-head signal transmission. Hence they are driven to endless expedients to cut down induction troubles, especially over composite circuits or on neighboring telephone lines. It is the 99 upper odd harmonics of the square-head waves which cause most of this trouble. When telegraph engineers also will adopt the sine-wave base of an uninterrupted alternating current for signaling purposes, not only will it be relatively simple to cut out the induction from such currents, but they will find a simplicity of operation and economies of time quite impossible so long as interrupted direct currents are employed.

The simplification in artificial lines and possibilities of multiplex telegraphy made available by the use of uninterrupted sine-wave currents are not the least among other advantages which this new principle places before both cable and telegraph engineers.

Surely, America, with its pressing telegraph needs, its long lines and its present complete freedom from bureaucratic restrictions, is the logical place for the evolution of the fruitful ideas which Colonel Squier has given us.

SELLING ELECTRICAL APPLIANCES.

The experience of the Chicago housewife, described by Mr. Vogel in this issue, contains several suggestions to the electrical merchandiser as to how he should conduct his business to make the most out of it. The average purchaser appreciates keen interest in his problem and the best means of meeting it, provided this is not carried to the point of annoying him, by trying to force a particular make of article upon him before he has decided whether it will best meet his needs. Other things being equal, however, the dealer who will follow up an inquiry and is ready to place an appliance upon trial will be more likely to meet with a sale than the one who is content to merely display and explain his wares.

Every purchaser appreciates attention, and, of course, courtesy is to be taken for granted. Suggestions as to what will best meet the problems of the home and lighten the work of the housewife are nearly always gratefully received and frequently lead to sales. The fact that the prospective buyer wishes to investigate other makes of devices should not discourage the earnest salesman. It is really an evidence of intelligence and should encourage the salesman who really believes in the merits of his merchandise that he can make the sale, even in competition with other brands. A little follow-up work, however, is frequently necessary to do this, and tact and resourcefulness come into play in the manner of carrying this out. In the instance cited, it does not necessarily follow that the washing machine finally sold was the best of its kind. It was, however, one that would do the work satisfactorily, and, this, coupled with efficiency and discretion upon the part of the salesman, culminated finally in a purchase. The same result will ordinarily follow the same sequence of events. When an entrance to the home has once been secured, it is often easy to make further sales by careful observation of the needs, or the lack of conveniences for which there is an excellent opportunity.

COMPETITIVE BIDDING.

The cost of any job of electrical installation is made up of three portions: the cost of material, the cost of labor and the overhead expense. Before making a bid upon any piece of work, the electrical contractor should have estimated these items as accurately as possible. The cost thus estimated forms the minimum which he may bid without likelihood of losing money on this particular job. His actual bid may vary from this figure upwards. The margin between the bid and the estimated cost constitutes expected profit.

When there is knowledge that others are also bidding upon any particular piece of work, there is temptation to reduce the amount of the tender to a figure which will be low enough to get the contract, and many contractors succumb to this temptation. They are especially likely to do this when their methods of estimating are so loose that they do not feel confidence in the calculated figures for the cost of the job. In a majority of cases, however, bids which are made without knowledge of the probable cost, or which are made lower than the estimated cost, result either in a loss to the contractor or else in skimping the material or the workmanship in a way which is not only dishonest, but is likely to give the perpetrator a bad reputation

Bidding in competition with others is not necessarily bad where each bid is based upon the actual estimate of the bidder. Competitive bidding, however, often results in one bidder endeavoring to find out the figures to be submitted by his competitors and cutting under them, or else in a general contractor actually making the matter an auction between the various bidders, quoting the prices of one against the other. The process is like an auction in more ways than one. An auction usually indicates a loss or sacrifice upon the part of one party in the endeavor to realize something regardless. Auctions are the magnet of the bargain hunter, the man who wants to get something for less than it is worth, while the other party loses. Competitive bidding is very similar and usually results in the contract going to the contractor who has made the biggest mistake or has taken the largest chance. The contractor who wins in a competition of this kind usually really loses and the man for whom the work is done gets a poor job.

The contractor who declines altogether to enter into competitive bidding, or who fixes a price independently of others and irrespective of the fact that others are bidding on the same work, is the one who will ultimately build up the choicest kind of business, and one that will not be wrecked by some unlucky development in a piece of especially large work. He will have a chance to build up a reputation for first-class work and will usually find there is enough of this kind wanted to make him independent of the contracts which are only to be obtained by the auction route.

A NEW STEP IN STREET ILLUMINATION.

Street lighting was the earliest application of electric lighting and remains one of its most important branches. Relatively speaking, however, the progress in electric street lighting since its early days has not been so marked as that in other fields of electric lighting, at any rate it has not been predominantly of a scientific character. Where some of the most successful street-lighting installations have been made it has usually been as the result of trials of various types of units arranged at different spacings and mounting heights, from which the seemingly best combination has been selected.

In marked contrast to this "hit and miss" method is the planning of a system based on a careful study and analysis of the actual requirements to be met, followed by the selection or special design and arrangement of equipment that can be predetermined as best meeting these requirements. Such an installation, when designed by an experienced illuminating engineer of good judgment, should prove a decided advance in the art.

It is a pleasure to be able to describe such an installation that has actually been begun in the city of Milwaukee. The first portion of an article on this system appears on other pages of this issue. Of the many distinctive features of this system one of the most interesting is that its design was preceded by probably the most extensive general and detailed survey of the entire subject of street illumination ever undertaken. Fully a year was spent by a large and able engineering corps in gathering the data, making an analysis of actual requirements and drawing up the general design of the system.

Probably the most important feature in this installation is that it is designed for uniform illumination of the street surface and those streets already lighted in accordance with the completed scheme actually have an exceptionally uniform illumination and that of a high intensity. The great superiority of such illumination over the spotty effect usually met with is so marked as to cause one to wonder why it has been attempted in only so few instances. Where almost unlimited funds are available it is easy to provide such lighting, but when it is done at almost no additional cost over antiquated and inadequate lighting, as is the case in Milwaukee, the result is a noteworthy achievement.

Among other interesting features in the new Milwaukee system are the almost exclusive use of concrete posts, lamp fixtures of original and ornate design, supply from standard central-station distributing circuits, automatic time switches for controlling the lighting circuits, elimination of constant-current regulators, almost entire absence of overhead circuits in the streets, permanency and neatness of the complete installation. That all these desirable features can be incorporated in a street-lighting system in an economical manner indicates that there has been made an important advance in street illumination.

Happenings in the Industry

Important Topics Discussed by Minnesota Electrical Association at Minneapolis Convention—3,000 Engineers at New York Meeting Adopt Preparedness Resolutions—President Johnson, of Vehicle Association, Sees Great Future in Affiliation With N. E. L. A.—Meeting of Electrical Jobbers in New York—Miscellaneous News Notes

VARIOUS TOPICS DISCUSSED BY MINNESOTA ELECTRICAL ASSOCIATION AT MINNEAPOLIS.

Report of the Closing Sessions of the Ninth Annual Convention of the Association.

While the discussion concerning the practicability of the electric range was the feature of the ninth annual convention of the Minnesota Electrical Association, held at the Hotel Radisson, Minneapolis, Minn., March 21 and 22, many other questions of importance to central-station men were considered during the sessions of the last day of the convention. Following the sessions on March 21, a report of which was printed in last week's issue, a number of papers on varied topics were presented.

H. S. Whiton, superintendent of the manufacturing department of the Minneapolis General Electric Company, and J. L. Lawrence, who occupies a similar position with the St. Paul Gas Light Company, presented a paper on "Boiler Plant Efficiency." This paper brought out points of cleanliness for efficiency, beginning with the boiler room proper and then including the various pieces of apparatus in a boiler room, such as boiler tubes, feed-water heaters and economizers. Efficiency of maintenance was emphasized, boiler-setting, pipe and valve leaks being cited as extremely wasteful and due entirely to neglect. Central-station men were advised to buy coal on specifications after chemical analysis and tests, and to keep more and better records of boiler-room apparatus. A number of charts showing analyses of the combustion of coal were shown. The discussion, participated in by T. D. Ramm, St. Paul; Ludwig Kemper, Albert Lea; A. J. Bemis, St. Cloud, and others, emphasized the need of saving in coal consumption and of more instruments for recording boiler-room performances.

E. J. Le Blond, assistant electrical engineer, Minneapolis General Electric Company, presented the report of the Committee on Rural Extensions. The committee made out a list of 24 questions regarding general practice in furnishing power and light to farmers, these questions being mailed to over 200 operating companies in Minnesota and other states. The information received was tabulated and abstracted, and showed the trend of modern practice in regard to rural extensions, every phase of the service being considered, and bringing out valuable data and many points of interest.

H. E. Eisenmenger, assistant engineer, National Lamp Works of the General Electric Company, gave a paper on "Concentric Wiring." He outlined the relations between central stations and small consumers, stating some of the advantages of flat rates for this class of service in different countries, particularly in Europe. He then gave a review of the construction and evolution of concentric wiring. A number of slides showing the use of current-limiting devices for flat-rate customers were shown. The discussion was participated in by representatives of the insurance companies, electrical inspectors and central-station owners.

The afternoon session began with a paper by Prof. W. T. Ryan, of the University of Minnesota, on "Central-Station and Electric-Transmission Statistics," which gave figures on waterpower resources in the United States, central-station investment and income, high-tension transmission lines, and economic and other interesting statistics concerning central stations in this country.

O. A. Rofelty, of the credit department of the Minneapolis General Electric Company, read a paper on "The Attitude of the Central Station Towards the Consumer." He stated that the proper attitude had more earning capacity than most efficiency devices, and stated numerous correct attitudes that should be assumed, that rebates should be made promptly and on fast meters, even if no complaint had been made, was brought out in the discussion by Ludwig Kemper, Albert Lea; W. L. Wadsworth, Minneapolis, and B. N. Cowperthwait, Faribault.

The following officers were elected for 1916:

President, Ludwig Kemper, Albert Lea; first vice-president, W. R. Harvey, Warren; second vice-president, E. W. Erick, Canby; secretary-treasurer, F. R. Porter, St. Cloud; executive committee, T. D. Crocker, Minneapolis; D. J. Fleming, Red Wing and E. F. Strong, Waconia.

The annual banquet, held Wednesday evening, was largely attended. Ex-Congressman J. Adam Bede, of Minnesota, was the principal speaker of the evening. Among the entertainment features of the convention were inspections of a number of Twin City industrial plants. The Northwestern Electric Company, of St. Paul, chartered two street cars for a party of 140, which inspected the company's new building. The company was also host at a banquet and provided entertainment for its guests.

Engineers Adopt Preparedness Resolutions.

At a special meeting in New York on March 20, attended by 3,000 engineers, the following resolutions were adopted:

The engineers assembled in public meeting on March 20, 1916, under the auspices of the Engineers' Committee on Military Lectures, believe that it is unworthy a great nation like the United States and that it is dangerous to the peace, safety and liberty of its people, to remain in our present position of inadequate military, naval and industrial preparedness.

We believe that between pacifism and militarism there is a just, safe and proper ground, greatly in advance of our present position—a ground which involves large additions to both the navy and army, a large increase in our schools for training officers and a co-operation and mobilization of the physical and industrial resources of the nation.

We believe that this nation should never make war except to enforce peace; that when strongly supported by armed resources its influence in maintaining its own liberties and rights, and the liberties and rights of the weak and oppressed throughout the Americas, will be greatly strengthened.

We believe that Congress should give due weight to the opinion of experts and should then appropriate sufficient money to put the nation in a position of defense against attack on either the Atlantic or the Pacific Coast.

We demand that our representatives in Congress act in accordance with this expression.

Many prominent electrical engineers are among those subscribing to the foregoing resolutions.

Affiliation of Vehicle Association with N. E. L. A. Marks Epoch in Electric-Vehicle Industry.

"The affiliation of the Electric Vehicle Association of America with its older and larger sister society—the National Electric Light Association—marks an epoch in the history of the electric-vehicle industry," according to W. H. Johnson, president of the Electric Vehicle Section, N. E. L. A.

"During the past six years the far-reaching and aggressive activities of the Electric Vehicle Association of America, through its membership which has been tripled in the last few years to approximately 1,200, has attracted the attention of the National Electric Light Association, and it has been felt that if closer relations could be established between the two Associations that the prestige which the National Electric Light Association has acquired in its 39 years of useful life, would materially assist electric-vehicle propaganda. Considering that the National Electric Light Association numbers among its 14,000 members the majority of the 6,000 central stations in the country, such an affiliation is especially desirable.

"In turn the electric-vehicle co-operative activities would increase the scope of the National Electric Light Association, thereby adding to its usefulness and strengthening its influence in which all electrical developments would profitably participate. Furthermore, co-operation between the two Associations would tend to centralize educational and development work, and would mark a desirable step toward eliminating duplication which frequently results when two or more associations attempt to cover in whole or in part like fields.

"The electrical industry is generally regarded as the best organized commercial group. As electricity is destined to supersede all other forms of energy for light, heat and power, and as such a condition can be more readily and easily secured through the scientific co-ordination of all related efforts, it would appear desirable to bring the efforts of multifarious developments together into one, great, highly organized body whose carefully systematized work would rapidly assure results that might otherwise be delayed if sought through miscellaneous and distinct bodies.

"It will therefore be apparent that the affiliation of the Electric Vehicle Association of America, including its executive officers and entire staff, with the National Electric Light Association, to be known as the Electric Vehicle Section, represents a distinct advancement calculated to considerably strengthen the Associations' positions and to secure greater results."

Electric Vehicles Discussed at Chicago.

That the electric vehicle presents the cheapest method of trucking, especially where short hauls or frequent stops are a characteristic of the service required, was strikingly brought out at a meeting on Monday evening in Chicago. The Chicago Sections of the Electric Vehicle Association and the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers held a joint meeting in the rooms of the latter society.

Four short papers were presented, the first three being illustrated with lantern slides. F. A. Putt discussed "Automobile Motor Characteristics," showing the required characteristics and giving curves of actual performance of this type of motor. High efficiency is necessary, combined with light weight and ruggedness.

Gail Reed spoke on "Accomplishments of the Electric Passenger Car." He showed the influence which the electric car has had on gasoline-car development and also upon the development of storage batteries. He pointed out the refinements of the modern electric car and illustrated the latest types.

W. J. McDowell read a paper on "The Electric Commercial Vehicle." He rehearsed the evolution of the truck and indicated the special service for which it is recognized as the most efficient type of commercial vehicle. For short hauls it can be operated at a cost of only one-half to two-thirds that of the gasoline motor truck. The last paper was by W. F. Hebard on the subject "Storage Battery Industrial Trucks and Tractors." He pointed out the various applications of this type of truck and showed its advantages.

The subject was discussed by Messrs. Postel, Jones, Street, Dent, Cook, Bowman, King, Naylor, Montgomery, Mabbs, Milton, Frankel, Pearson, Bates and McRae. It was pointed out that the rising price of gasoline is making the advantage of electric operation all the more pronounced and the factories of the manufacturers are now running at full capacity. Data given showed the cost of electric energy to be a small part of the total. Batteries have to be renewed at periods of from one to five years according to type.

Public Utility Companies of Utah Submit Tax Schedules.

The Utah Power & Light Company, through its tax agent, C. M. Brown, has submitted to the Utah state board of equalization schedule of its taxable property in the state, together with a statement of the value of such property. According to the statement this company owns properties to the value of $5,472,890 in the state of Utah and in addition has leased from the Utah Light & Traction Company property with a total value of $3,424,055.

Group of Eminent Telephone Men in Washington.

On the occasion of the recent dinner of the National Geographic Society, at Washington, D. C., in recognition of the recent development of the telephone in its relation to long-distance conversation, and in honor of the gentlemen responsible for this development, an interesting group photograph was taken on the steps of the Society's building, and is reproduced on this page. The picture shows

Group of Well-known Telephone Men at Washington, D. C.
Front Row: Theodore N. Vail, Alexander Graham Bell.
Second Row: Union N. Bethell, Thomas A. Watson, John J. Carty, Gilbert H. Grosvenor.

the distinguished gentlemen at an unposed moment, descending the steps of the building.

Mr. Vail and Dr. Bell met on this occasion for the first time in 30 years. In the first days of the telephone they saw a great deal of each other, but for the last three decades their visiting has been done largely through the medium of the telephone.

The present picture was taken on March 7, 1916.

Atlantic Division of Electrical Jobbers Meets in New York.

The Electrical Supply Jobbers' Association, Atlantic Division, met in New York City, at the Hotel Biltmore, March 23 and 24. The attendance was thoroughly representative and numbered about 60 delegates. Frank S. Price, of Pettingell-Andrews Company, Boston, was chairman of the meeting, and Franklin Overbagh general secretary. The session were essentially executive and were attended only by the electrical jobbers.

A number of interesting, practical subjects were discussed at length. Following are the titles of the subjects, with names of those who led the discussion:

(1.) Do purchases from manufacturers during the past six months and at present represent: (a) Demand for present consumption; (b) Desire to provide for future requirements; or (c) Speculation? E. C. Graham, of the National Electric Works, Washington, D. C., and V. C. Bruce Wetmore, of Wetmore & Savage, Boston, led in the discussion.

(2.) Have the jobbers reasonable ground to expect an abnormal demand this spring from: (a) New construction in office buildings, hotels, or residences; (b) Industrial plants; (c) Transportation lines; (d) Old residences? W. E. Robertson, of the Robertson Electric Company, Buffalo, opened the discussion.

(3.) Do present conditions in the copper market warrant the jobbers to expect lower prices for copper during the next six months? George L. Patterson, of Stanley & Patterson, Inc., New York, opened the discussion.

(4.) Do present conditions in the steel market warrant the jobbers to expect lower prices for steel during the next six months? George W. Provost, of the Union Electric Company, Pittsburgh, opened the discussion.

On the second day the following subjects were taken up: (1.) What is the condition of the rubber-covered wire market as to manufacturers' and jobbers' stocks on hand, deliveries, prices, demand, etc.? M. A. Oberlander, of the Western Electric Company, New York, opened the discussion.

(2.) What is the condition of the rigid-iron-conduit market as to manufacturers' and jobbers' stocks on hand, deliveries, prices, demand, etc.? J. A. Pizzini, of the Western Electric Company, opened the discussion.

(3.) What is the condition of the metallic-flexible-conduit market as to manufacturers' and jobbers' stocks on hand, deliveries, prices, demand, etc.? C. P. Scott, of the Royal Company, opened the discussion.

(4.) What is the condition of the schedule-material market as to manufacturers' and jobbers' stocks on hand, deliveries, prices, demand, etc.? F. S. Price, of Pettingell-Andrews Company, Boston, opened the discussion on this subject.

(5.) What is the condition of the miscellaneous stock market as to manufacturers' and jobbers' stocks on hand, deliveries, prices, demand, etc.? A. M. Little, of the Mohawk Electrical Supply Company, Syracuse, N. Y., opened the discussion. The meeting began at 10 a. m.

The next meeting of the Atlantic Division of the Electrical Supply Jobbers will form part of the general meeting to be held at Hot Springs, Va., in May next, on which occasion manufacturers and all others interested will be present.

Bonus to Employees of General Electric Company.

E. W. Rice, president of the General Electric Company, sent notices last week to all plants of the company that all employees in the service of the company for a period of five years or more would receive a bonus of 5 per cent of a year's salary, payable in two installments. It is estimated this will mean a distribution of over $1,000,000 per annum to employees.

According to the bulletin, the first installment will be payable on or before August 1 of this year and will be a sum equivalent to 5 per cent of the individual earnings for the six months ending June 30, 1916. The second payment will be made on or before February 1, 1917, when 5 per cent of the individual earnings for the six months ending December 31, 1916, will be distributed. By the arrangement of two payments many employees who would not be entitled to participate in the distribution if all were paid in one installment will share in the second distribution, having completed the five years' service between June 30 and December 31.

The distribution, as stated by officials of the company, is being made by the company to signify its appreciation of the services of the employees who have been with the company for a term of years, and is a result of a desire to promote long, faithful and efficient service by its employees.

An Emergency Pole Installation in Texas.

That the automobile can be used in almost any capacity is shown by the accompanying illustration, which shows a 60-foot pole attached to a Ford roadster by means of a trailer. The necessity for quick action was caused by a pole burning down on a transmission line of the Texas Power & Light Company. The pole shown was secured from a neighboring store yard and hauled about 15 miles, via the Ford.

Handling Poles in An Emergency. A 60-Foot Pole Ready for a 15-Mile Dash Across Texas Prairies to Replace a Burned Pole.

Miscellaneous NEWS NOTES

Detroit Edison Company Publishes House Organ.—The Detroit Edison Company has inaugurated the publication of a monthly house organ which is termed the "Synchroscope" and which, it is stated, will deal with all inter-departmental activities of the company. The March issue contains an interesting article on "Load-Water-Rate Curves Applied to Plant Operation," by W. A. Hirt, and an article on electric steel furnaces by E. L. Crosby.

California Company to Pension Employees.—General Manager John A. Britton of the Pacific Gas & Electric Company, San Francisco, Cal., has perfected plans for a pension system for the old employees of the firm. The company has been pensioning some of its employees, but the system did not extend to all.

Kentucky Companies Inaugurate Safety-First Campaign.—A joint safety-first campaign has been inaugurated by the Paducah (Ky.) Light & Power Company and the Paducah Traction Company. The work is to be handled through four employees' committees, of which Manager W. L. Weston has named the chairmen.

Section of A. I. E. E. for Kansas City.—A petition has been prepared, with the necessary signatures, for the locating of a section of the American Institute of Electrical Engineers at Kansas City, the district including St. Joseph, and Excelsor Springs, Mo., and Lawrence, Leavenworth and other Kansas cities.

Jersey City Electrical Contractors Organize.—A number of electrical contractors in Jersey City, N. J., are forming an organization to be called the South Hudson Electrical Contractors' Association, Louis Fort being temporary chairman. Cooperation and a uniform price list for electrical supplies is the purpose of the association.

Commission Approves Sale of Electric Companies.—For economic reasons the Pennsylvania Public Service Commission has approved the sale of the Eastvale Light Company and Beaver Valley Electric Light, Heat & Power Company to the Beaver County Light Company. The latter company owns seven other power companies in Pennsylvania. The sale was approved because the holdings could be operated more conveniently and economically.

Copper Wire Stolen from Louisville Companies.—Special attention is being paid by all concerns with copper wire distributing systems in and around Louisville, Ky., to the safety of their property, since several instances of wrecking of these systems merely for the metal have come to light. The most daring attempt of this kind was perpetrated by three men on a Western Union cable over the K. & I. bridge. A 50-foot section was cut away with a hatchet. Two instances of similar theft are reported by the Louisville Traction Company. A switch trolley was cut at the positive end first, and 100 feet of copper was stolen. Another attempt was frustrated after thieves had cut a trolley at the dead end and it dropped to the tracks, throwing open the circuit-breaker in the power-house.

New Turbine for Boston Elevated Railway.—A new steam turbine of 35,000-kilowatt rating will be installed at the South Boston alternating-current generating station of the Boston Elevated Railway Company, to provide for increasing power demands of the system. The installation of this large unit conforms to the recommendations of the Stone & Webster Engineering Corporation in a report to the company on the most efficient means of increasing the power supply. In the report the engineers pointed out that, while the first cost of a 35,000-kilowatt turbine is about $200,000 more than for a 20,000-kilowatt unit, installed, the economy of operation with this turbine carrying the station base load, would compensate for it in five years.

Directory of Electricians in Massachusetts.—A 220-page booklet, giving the names and addresses of licensed electricians of both the Masters' (Class A) and the Journeymen's (Class B) grades has been issued by the State Board of Electrical Examiners of Massachusetts. The list is arranged by cities and towns, and is a convenient handbook for use in checking up authorized electricians in the state. The laws relating to the licensing of electrical workers are also presented.

Chicopee, Mass., to Keep Municipal Light Plant.—The Committee on Public Lighting of the Massachusetts Legislature has given the petitioners for legislation authorizing the sale of the city of Chicopee's municipal lighting plant "leave to withdraw." A Chicopee attorney has secured the necessary number of signatures to introduce the bill, but at the final hearing in Boston no one appeared in favor. The mayor, city solicitor and representative spoke briefly against the bill, stating that there is no sentiment in Chicopee in favor of disposing of the plant. Among those recorded against the bill was General Morris Schaff, a member of the Gas and Electric Light Commission.

Los Angeles Jovians Discuss Workman's Compensation.—At the meeting of the Los Angeles Jovian League, March 22, T. Harvey Dukelow, claim agent for the Southern California Edison Company, gave a half-hour talk on the "Workman's Compensation and Insurance Law" which became effective in California, January 1, 1914. The theme of his address was "Safe and Sound" and in his talk he made the following comments: "The companies are now fully awake to the significance of education as a prevention of accidents. Technical skill is desirable, but so, also, is education that will develop mental alertness, accuracy of judgment and a genuine and lively interest in the company. Education is imperative for bringing the workman to a clearer appreciation of life and its responsibilities and making him more alert to the opportunities and dangers of his profession. But the man who has been at a trade for years is set in his ways and intolerant of change and, unfortunately, this has its bearing on others. Thus, we turn more and more to the younger man—the new hand at the business—and endeavor to produce workmen who not only will tolerate safeguards, and will use them, but who from force of habit will be addicted to safe methods of working."

Louisville Central Station Subscribes $25,000 to Industrial Fund to Secure Industries.—The Louisville Gas & Electric Company is the latest Louisville, Ky., concern to make a subscription to a proposed million-dollar fund which would be used by commercial interests of that city in establishing new industries there. A contribution of $25,000 is provided for conditionally in the action of the Board of Directors, $5,000 to be set aside each year for five years. This makes $40,000 subscribed without any effort to obtain subscriptions. The electric company conditions its subscription on the expectation that other contributions will be made to bring the sum up to the required figure, that it shall be safely administered, etc. It is expected that the fund will be in the hands of a division of the Board of Trade, an Industrial Bureau having been undertaken by that body. Donald McDonald, vice-president and general manager of the electric company, announced the contribution and stated that he and the directors hope to see the fund completed in time to meet proposed tax reforms which would improve conditions for new industrial enterprises in Louisville. Numerous other concerns, it is understood, have decided voluntarily on subscriptions but are waiting for further developments before announcing them.

First 1,200-Pair Cable in Boston.—The first 1,200-pair 24-gauge underground cable in the Boston metropolitan district is about to be installed by the New England Telephone & Telegraph Company, to provide facilities for additional trunk lines and local growth in the Back Bay exchange.

American Association of Engineers Enlarges Its Offices.—The American Association of Engineers has moved to suite 601-604, 29 South La Salle Street, Chicago, Ill. This is the second time in nine months the new society has been compelled to enlarge its quarters. It has now a membership of 500, 65 per cent of which is in and near Chicago.

Mississippi to Place Restrictions on Municipal Utilities.—A house bill has been introduced in the Mississippi Legislature authorizing cities of 10,000 or more inhabitants to construct lighting, water and power plants when the income therefrom will in five years pay for the investment and to issue five notes due annually in payment therefor.

Continued Improvement by Standard Gas & Electric Company Shown in Annual Report.—In his annual report to the shareholders of Standard Gas & Electric Company for 1915 H. M. Byllesby, president, maintains the policy of complete and candid publicity adopted several years ago, and shows that the company has made substantial progress during the year, while at the same time permitting subsidiaries to reinvest a large amount, $1,322,792, in the properties through depreciation reserves and undistributed surplus.

Earnings, after the payment of fixed charges, amounted to 6.3 per cent on the preferred stock, upon which dividends were paid at the rate of 4 per cent, leaving a surplus for the year of $270,979. The number of customers served advanced from 308,378 in 1914 to 325,153 in 1915.

Worcester (Mass.) Central Station to Expand.—Directors of the Worcester Electric Light Company, at their monthly meeting, March 15, voted to recommend to the stockholders that 2,000 shares of new capital stock be issued, at $200 per share, the proceeds to be used to pay for proposed additions to plant which will about double the capacity of the Webster Street power station. The company will probably install a 20,000-kilowatt turbo-generator and add to the station an extension 68 by 78 feet. Plans are being prepared by H. R. Kent & Company, New York. A special meeting of the stockholders will be held April 26 to vote on the stock issue. The company's present capital stock is $1,400,000.

Flood Lighting Planned for Utah Capitol Building.—Secretary of State David Mattson, of Utah, has proposed to the Utah State Capitol Commission that this magnificent new building be illuminated by means of flood lighting at the time of its dedication and thereafter. The building is located on a high bench on the east side of Salt Lake valley at a point where it can be seen readily from all points of the valley. The building is faced on the exterior with a very light colored granits, which lends itself readily to the flood-lighting scheme. The architecture of the building is such that particular striking and beautiful effects in lights and shadows could be produced with a flood-lighting system. W. d'A Ryan has examined the building and pronounced it particularly well adapted to the installation of a flood-lighting system.

New Personnel of New York Commission.—The Senate of the State of New York on March 16 confirmed the nominations made by Governor Whitman of Travis H. Whitney and Charles S. Hervey, both of Brooklyn, to be members of the Public Service Commission for the First District. Mr. Whitney succeeds Commissioner J. Sergeant Cram, whose term expired January 31, 1916. His term of office, therefore, will expire January 31, 1921. Mr. Hervey succeeds Commissioner George V. S. Williams, who resigned in January. Mr. Hervey's term will expire January 31, 1917. Commissioners Whitney and Hervey were sworn in at Albany on March 17, and both immediately entered upon their new duties. With their accession the membership of the Commission for the First District again became complete. It is now an entirely new Commission, the oldest member, in point of service, being Col. William Hayward, who took office April 1, 1915. The new chairman, Oscar S. Straus, was appointed in December, 1915, and Commissioner Henry W. Hodge in January, 1916.

Plan Electrically Lighted Lincoln Highway Between Illinois Towns.—The section of the Lincoln Highway between Aurora and Geneva, Ill., a distance of 10 miles, is to be electrically lighted for the benefit of travelers at night. This follows close upon the news that a rural section of the Lincoln Highway leading out of Salt Lake City, Utah, has been so lighted, and proves the value of the closer communication established through the development of the Lincoln Highway.

Aurora is known as the "City of Lights," and the new arrangement will complete a system which is now favorably commented upon by all visitors. Decorated Lincoln Highway lights are found along the route of the Lincoln Highway in Aurora and electrically lighted warning signals have just been placed at the street-car crossings. They were supplied by the local automobile club, and the street-railway company furnishes the power.

Incinerating Plant at Boston Proves Economical.—An incinerating plant, consisting of furnace room, baling room and sorting shed, has been built by the Boston Edison Company adjoining its heating plant at the Service Building. Heretofore waste has been hauled to the dump. With the plant on the grounds, the haul is much shorter, and materials can be disposed of oftener, thus reducing fire risk. The plan of sorting the materials results in the salvage of much straw, paper, etc., which is baled and sold. This also allows more or less reclaiming of missing objects.

Insulated wire in short lengths is reduced to metal, 2,000 pounds being handled in 20 minutes. Returned coupling boxes are burned out preparatory to repairing and putting in stock, and office waste and useless materials are disposed of. Wooden materials, boxes, barrels, reel lagging, etc., are, however, separated from the other debris and either sold or used in starting boilers.

During 1915 the Edison Company sold 1,077 tons of metal, worth $107,096. About 90 per cent required only sorting. The other 10 per cent was made available by reduction.

New England Power Company Makes Good Showing.—An output of energy, larger by 50,000,000 kilowatt-hours than in any previous year, is reported by the New England Power Company, for 1915. The company says the demand for power is so large that the great problem is to provide increasing supply to meet the growing requirements of customers. This increase is due both to the great business activity and the purchase of electricity by more manufacturing and utility companies.

During the year plant No. 5, on the Deerfield River, went into partial operation, producing 35,000,000 kilowatt-hours. High-tension lines were extended south from Uxbridge, Mass., through Woonsocket to Providence and Pawtucket, R. I., and a substation placed in operation for supplying energy in central Rhode Island, in which state contracts for over 15,000 horsepower have been closed, with others pending. Connection has been made at tidewater with two steam plants.

In July, 1915, a plant and water power on the upper Deerfield, at Readsboro, Vt., were acquired and the dam and hydraulic plant have been rebuilt, and a new hydro-electric station is now under construction, to be in operation about April 1. The ownership of this property, which has an available head of 72 feet, gives the companies the entire control of the Deerfield from just south of Wilmington, Vt., to Shelburne Falls, Mass., 35 miles.

The New Street-Lighting System of Milwaukee

Part I

This article describes a street-lighting system which incorporates in a unique manner the latest scientific and practical developments of the art and which very economically provides uniform street illumination of a relatively high intensity. The extended survey that preceded the design of the system is briefly summarized. Some of the more original features of the plan are described. In the second part of the article, to appear next week, further technical details will be taken up and cost data given.

In the city of Milwaukee, Wis., the first section of a new municipal street-lighting system has been installed, which in its entirety is decidedly unique. It includes many novel features that have been tried out with complete success in other installations, but in no case known has such a large number of new elements been incorporated in a single installation. The new system is also unique in being the first instance in which a street lighting system on a large scale has been laid out after a prolonged preliminary study of the scientific and practical requirements of street illumination and in strict accord with the most advanced principles of illuminating engineering.

Conditions Prevailing Before New System was Proposed.

To understand what led to the scheme for complete rehabilitation of street lighting in Milwaukee, a brief review of the situation is desirable. The city is situated on the west shore of Lake Michigan and possesses excellent facilities for shipment by rail and water, which among other things have promoted its rapid industrial development in recent years. To accommodate the increase in population, which in 1915 was estimated by the United States Census Bureau as 428,000, outlying parts of the city are rapidly building up and several suburbs have been annexed. In these outlying sections the street lighting has either been extremely meager or entirely absent, many miles of streets having been laid out that are as yet unpaved and unlighted. In the more settled parts of the city the street lighting has also been very inadequate. Even on some of the principal business streets the practice was still followed of suspending an old arc or some obsolete type of lamp across the street at intersections only.

As the result of these unsatisfactory lighting conditions accidents from collisions, especially with automobiles, were common and the work of the police was hampered. Burglaries and other crimes increased, particularly assaults on women. These led to a strong agitation for improved street lighting and the city authorities realized that something would have to be done. Complicating the situation, however, was a movement for a municipal electric plant to be built primarily for street lighting; this was urged by the Socialists, who dominated the city government for several years without proceeding further than purchasing a site for the proposed plant, however.

Street-Lighting Survey Undertaken.

The agitation for improved street lighting resulted in January, 1914, in the City Council voting in favor of having a study of the entire subject made, but for some months little headway was made in this until in June, when F. A. Vaughn, of the consulting engineering firm of Vaughn, Meyer & Sweet, was appointed engineer of street-lighting survey. The work was then undertaken in earnest. Mr. Vaughn was ably assisted by A. J. Sweet and a large engineering staff.

A brief outline of the extended scope of this survey is of

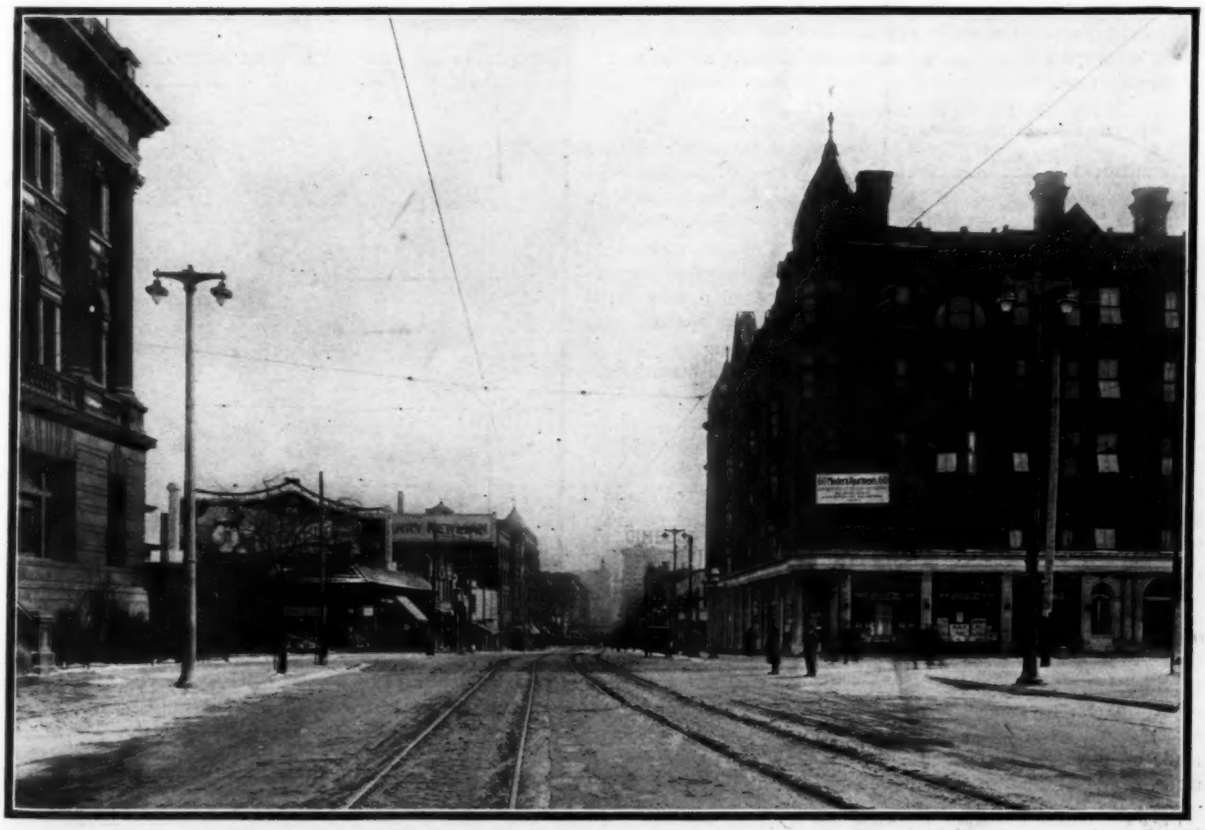


Fig. 1.—Day View of Grand Avenue, Milwaukee, Looking East from Public Library and Showing 30-Foot Double-Bracket Posts.

interest. One of the first things considered was an analysis of the general principles of street illumination, involving a study of the various objects of street lighting, an investigation of the methods of discernment outdoors at night and to what extent they satisfy these different objects, a review of the methods of generating light efficiently and of utilizing it efficiently

Fig. 2.—View in Twelfth Street, Showing 22.5-Foot Single-Bracket Posts and Former Lighting Arches Still in Place.

and in such a way as to leave the eye in a condition to perform its visual functions efficiently. A summary of the findings of this part of the study was presented in a paper[1] by Mr. Sweet before the Illuminating Engineering Society at Chicago on May 21, 1915.

New Design Determined On.

In continuing the survey it was found that the street-lighting equipment in use was not only obsolete and inadequate, but could not be remodeled to any practical degree so as to meet satisfactorily at least the most important requirements of a scientific street-lighting system. Therefore, it was determined to design an entire new system which would meet all these requirements efficiently. In working up a new design it was decided that it should be laid out to provide as far as possible directly from the start (and at any rate ultimately) for uniform illumination of the streets to intensities depending on the amount of traffic and use of the streets. It was found that uniform light distribution on a street is the only kind that permits of discernment by illumination effect and therefore much more fully satisfies all the requirements than the non-uniform illumination commonly produced from lamps far apart, which necessitates dependence to a large extent on silhouette effect.

How Survey was Made.

Before working out the features of the design, it was necessary to make a detailed analysis of street and traffic conditions throughout the city in order to determine exactly what were the illumination requirements of each street and block. The night traffic was gauged by the number of automobiles and street cars passing given points per hour. Field notes were made of these data, together with observation of street pavement, character and number of buildings, the presence, nature and density of trees and the height above ground of their lowest branches, and other conditions that affect street-lighting requirements. Large sectional maps of the city were then made to scale on which these data were recorded.

These observations disclosed the exact nature of the problem. Among the facts brought out were the following: The area of the city is about 37 square miles and the total mileage of streets is about 600, of which close to 26 per cent are paved with pavement having permanent concrete base. Nearly all the business streets have double-track street-car lines. The main business streets have buildings ranging all the way up to 14 stories in height; in the less important business streets two and three-story buildings predominate. In residence streets, two-story buildings are most common. In the better residence streets and boulevards, trees are plentiful, but as a rule are either old and high or can have their lower branches trimmed to leave about 15 feet above the ground clear. Many former residence streets are in a state of transition to business streets and the trees therein are rapidly dying.

Illumination Requirements and Lamp Selection.

After all these facts had been ascertained it was possible to determine the illumination intensities needed for the successive blocks of each street. In general it was found that five values of intensity would suffice, as follows:

Nature of Street.	Foot-Candle Intensity.
Alleys and outlying streets	0.01
Residence streets	0.03
Subsidiary traffic feeder or thoroughfare	0.06
Main traffic feeder or thoroughfare	0.12
Promenade and principal business street	0.50

Some variations from these values were necessary to meet special local conditions. The amount of light to be generated for each of these intensities was then calculated and entered on the maps in terms of lumens per running foot of street.

Fig. 3.—A Typical Residence Street with New 15-Foot Harp Post Contrasted Against Old Gas Post.

From this figure, together with the length of block and the number of lamps to be installed therein, the size of the necessary lamps was determined in lumens, this figure giving the total light units generated in the lamp, which is 10 times the rated candlepower.

After considering the subject of lamp selection from all angles, it was decided to recommend tungsten-filament lamps of the gas-filled type as the standard unit. Among factors in-

1 See abstract in ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, May 29, 1915, pages 999 and 1,000.

fluencing this choice were the high efficiency of these lamps, their steadiness and good quality of light, simplification of maintenance to monthly cleaning and occasional lamp renewal, possibility of using scientific reflectors or refractors, large range of sizes available, possibility of eliminating special substation equipment and adaptability to artistic fixtures. An inverted-mantle gas lamp, especially developed for the purpose, was also considered as a suitable alternative unit for certain residence streets.

Lamp Mounting and Spacing.

Although nearly all the electric lamps formerly in use in Milwaukee street lighting were suspended either by cables across street intersections or mounted on mast-arms, making the cheapest possible installation, this type of mounting was far from attractive and therefore was recommended to be used in an improved form and only at certain intersections and where it would prove unobjectionable. For the great bulk of the lighting a post mounting was chosen, this to be of simple, but artistic, design and at as great a height as local conditions would permit in order to place the lamps above the line of vision as far as possible and thus diminish blinding effect to a minimum.

Four standard heights of lamp mounting were selected: 15, 22.5, 30 and 45 feet from street surface to center of lamp. The first was to be used on posts in residence streets and boulevards where trees prohibit any greater height. The second for suspension and post units principally on secondary business streets, where any higher mounting would bring the lamps above the roof levels of the low buildings prevailing. The 30-foot height was selected for the principal business streets, important and unforested thoroughfares and boulevards where trees and buildings offered no restrictions. In a few public squares and large open spaces in parks, 45-foot posts were deemed most desirable. These two latter heights are an innovation in American practice.

Before determining the spacing distances, a study was made of a large number of prototype curves showing the light distribution which the lighting units would have to produce in order to give uniform illumination of the street surface for various ratios of spacing distance to mounting height. It was found that unless this ratio (designated by M) is eight or less, the shape of the curve cannot be approximated by any lighting units available, even when equipped with reflectors or refractors. The curve for M=8, shown in Fig. 4, can be practically obtained by equipping an incandescent lamp with a proper refracting globe. The curve for M=6 is still better. Therefore the ratio of M=8 was adopted as standard, except for the more congested streets where a ratio of M=6 was chosen and in some of the residence districts where M=12 was used.

This means that lamps 15 feet above the street are 15×8, or 120 feet apart, measured along the length of the street; lamps 22.5 above the street are 22.5×8, or 187 feet apart; lamps 30 feet above the street are 30×6, or 180 feet apart. These standard spacings were departed from only for local requirements and in cases where only part of the ultimate equipment was to be installed at first. For example, on a street with 15-foot

Fig. 5.—New 22.5-Foot Suspension Unit at Street Intersection Contrasted with Old Open Arc.

lamp mounting height, four lamps would be called for on a block of 480-foot length; however, at first only two of these lamps 240 feet apart might be installed, the circuit being arranged to permit the easy addition of the two other lamps a year or so later when more funds would be available. Even with this partial installation greatly improved lighting would be produced.

Other Features Recommended for New System.

The street-lighting survey was of such magnitude that it required practically a year for its completion. The report was submitted to the City Council by Mr. Vaughn in June, 1915; in printed form it covered over 70 pages, supplemented by numerous atlases of maps, drawings and tables; a supplementary report of 40 pages is just being published. Space does not permit giving more than an outline of the more important of the recommendations made, some of which have been already touched on in the preceding paragraphs. Among the other features provided for was that entirely new street-lighting circuits be installed and that these be supplied at convenient centers from the public utility distribution feeders through suitable transformers and time switches, the latter automatically turning the lighting circuits on and off at the proper time. These circuits were to be run like series circuits, without using

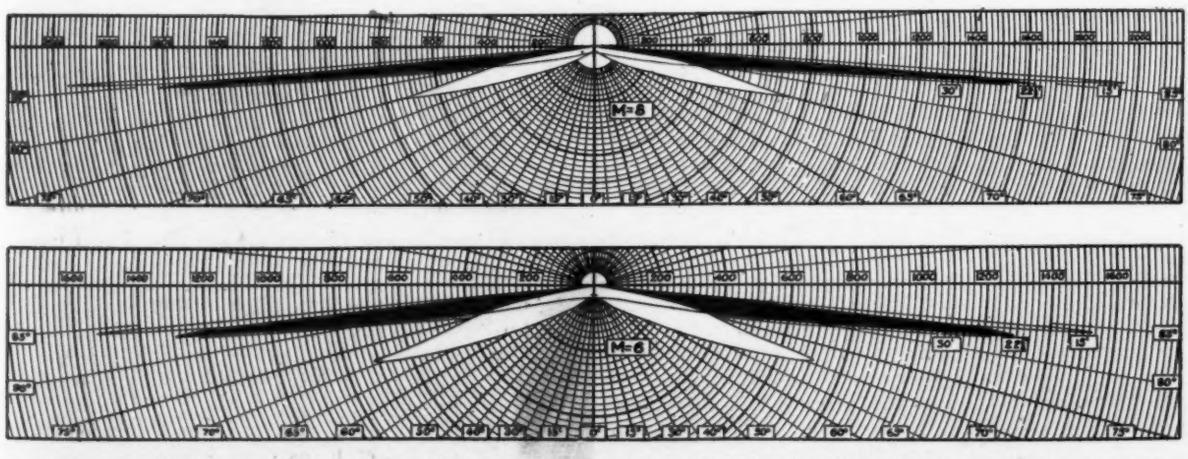


Fig. 4.—Protoype Curves for M=8 and M=6. White Area Shows Light Distribution Required for Uniform Horizontal Illumination, Black Area for Uniform Vertical Illumination.

constant-current regulators, however, the lamps being connected to the line through individual series transformers.

The special street-lighting circuits, together with the entire equipment of posts and lamps, were to be installed and owned by the city; bond issues were recommended to permit the major part of the equipment to be put in during the year 1916 and the remainder during 1917, the underground circuit being installed at the earliest possible time, especially in streets where new paving was to be put in. Purchase of energy for the electric lamps was recommended on the kilowatt-hour basis on a contract of five years; gas for gas lamps, together with maintenance of the mantles and burners, was likewise recommended to be purchased on a five-year contract. Maintenance of the electric lamps and of the electric circuits was recommended to be taken care of by the city. A good general review of the report and its recommendations, together with the reasons on which the latter were based, was contained in a paper presented by F. A. Vaughn before the Illuminating Engineering Society's last annual convention, September 21, 1915.

First Part of Installation Begun.

After deliberating on the report several months, the City Council in September, 1915, appropriated $34,000 to pay for installation of an initial part of the new system, this covering a section just west of the central part of the city in which improved lighting was urgently needed. The streets chosen included several types for which different types of units were called for in the new system. Thus this initial installation would typically demonstrate the possibilities of the new equipment and it was therefore called the demonstration installation. Based on its results would hinge the installation of the rest of the new system involving a total expenditure of over $1,250,000.

Work was begun late last fall and continued through the winter to completion in February. This demonstration installation covers 40 squares, or about three-fourths of a square mile; nearly eight miles, or 90 blocks, of streets have been equipped. The new equipment placed in service comprises the following:

No. of Units.	Height, Feet.	Type of Unit.	No. of Lamps. Electric.	Gas.
45	15	Harp post	45	....
22	15	Harp post	....	22
41	22.5	Center suspension	41	....
52	22.5	Single-bracket post	52	....
16	30	Double-bracket post	32	....
176			170	22

Design and Construction of Posts.

The designs of the posts used are shown in Figs. 1, 2 and 3. These simple and graceful designs, as well as that of the lamp housing or fixtures, were chosen through co-operation with a committee of the Milwaukee Chapter of the American Institute of Architects. Fully 72 per cent of all the lighting units throughout the city will be mounted on these ornamental posts.

All bracket and harp posts are made of reinforced concrete, this material being chosen chiefly on account of its strength and extremely low maintenance. Twelve of the posts are of cruciform section supplied by the Chicago Concrete Post Company, Chicago. The other posts are of tubular section and supplied by the Universal Concrete Products Company, Milwaukee. These latter posts are molded in horizontal position in one piece, even in the case of the longest posts, by a special centrifugal process that is said to insure a very strong and homogeneous tubular structure. Tests of the posts have shown them to possess abundant strength for the most severe requirements. None of the 45-foot posts has as yet been made, but they will probably be constructed in the same manner.

In the case of what is called the 30-foot post, the lamp is supported 30 feet above street surface, the post itself extending three feet above this point. The outside diameter just below the bracket is 7 inches and the diameter directly above the base is 13 inches; 8 steel reinforcing rods are spaced symmetrically around the two-inch pipe core, which forms a central wireway. Integral with the post is a base or butt extension 6 feet long, making the entire post 39 feet long. After the posts are set and cured, they are ready for erection. The foundation for the post is dug 6 feet deep and in this is poured a concrete hollow socket for the post. After this has properly set the post is brought to the site, lifted by means of an A frame and lowered with its butt into the concrete socket; cement grout is used to seal the joint around the base. The entire handling and erection of the post is much like that of iron trolley poles. No special difficulty was met in this work. A hole left in the side of the butt and a corresponding hole in the socket gives access to the center pipe for wiring.

The general construction and erection of the 22.5 and 15-foot posts is similar, as far as the shaft portion is concerned, to that just described. The brackets for the higher posts are also made of concrete and are mounted on top of the extended central pipe after the post has firmly set in place. A view of one of the 22.5-foot posts just before the bracket was put on is shown in Fig. 6. The 15-foot post has an ornamental harp casting for holding the lamp fixture.

Fig. 6.—A 22.5-Foot Concrete Post Ready for Mounting of Bracket.

At street crossings where lamps are suspended across the intersection, as on most residence streets and on some streets in a transitory state, tubular steel poles are now used, as shown in Fig. 5. It is possible that reinforced-concrete poles may be used for this purpose also in the extension of the system throughout the city. The lamp is permanently suspended from a steel messenger wire over the middle of the crossing; the lead-covered duplex supply cable passes up one post and is supported directly below the messenger by means of special cable clips, these also keeping the cable tightly stretched.

These lamps, like all others in the new system, are reached for cleaning and renewal by means of a tower wagon. By eliminating the lamp-lowering gear and by the use of slim, smooth poles, a neat and unobtrusive method of suspension is obtained, which is in striking contrast to the old type of suspension formerly used. Fig. 5 shows this, both the new and old lamps being in place.

Further details of this installation, together with cost data, will be published in the next issue.

(To be continued.)

Electricity in By-Product Coke Manufacture

A Description of the Manufacture of Illuminating Gas and Methods for the Utilization of Waste Gases for Generating Electricity for Use in the Manufacture of By-Product Coke

Industrial Power Series—Article No. 159.

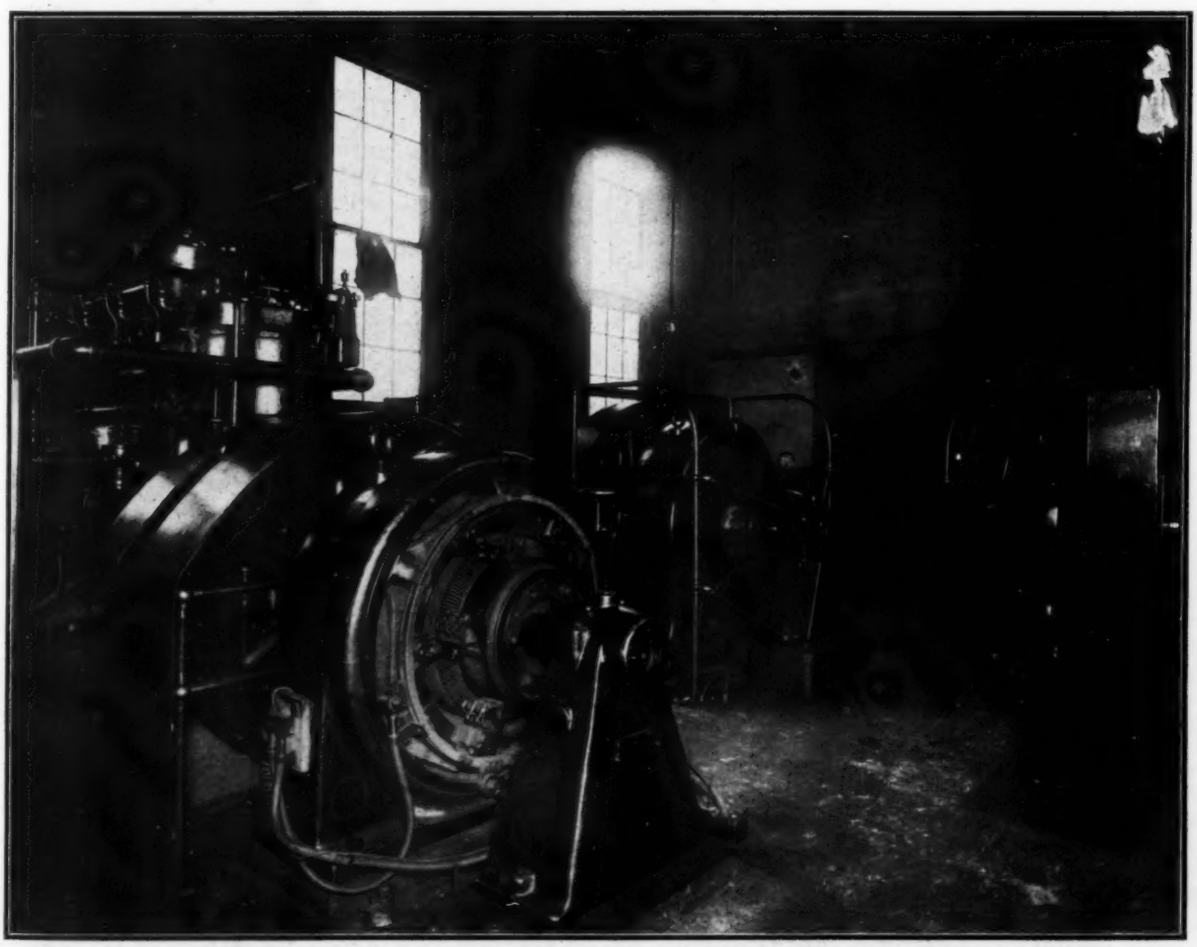
With the march of progress in the inauguration of new industries and with the developments in existing industries the field of endeavor of the operating and commercial engineer is broadening to such an extent that a superficial knowledge, at least, of manufacturing processes is demanded. Although there are few industries where the central-station service does not show a decided advantage over private plants, there are certain industries in which there are emitted from the processes large amounts of waste heat which can be used to economical advantage for the generation of electrical energy for use in connection with electric drive. Among such industries may be mentioned illuminating-gas plants and by-product coke plants, which are closely allied, where the waste heat from the ovens and the surplus gas from the retorts can be converted into useful work.

This article illustrates and describes the power equipment and some of the auxiliary apparatus of the by-product coke plant of the Semet-Solvay Company at Geneva, N. Y. This installation consists of two power plants, one steam and one gas, the former utilizing the waste heat from the coke ovens and the latter surplus gas from the retorts. It may be said, therefore, that the entire power requirements are furnished from waste products.

About 30 per cent of the output of coke in this country is made in by-product ovens, its chief use being for metallurgical and domestic purposes. The remaining principal product of commercial value from by-product ovens is illuminating gas. The latter product from this installation is marketed by the Empire Gas & Electric Company in towns and cities of Central New York.

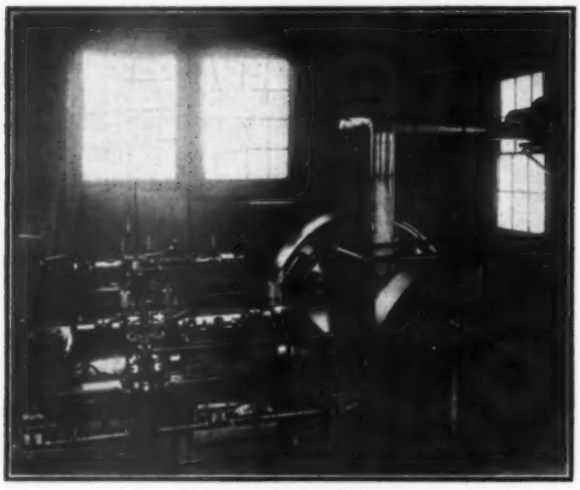
The Manufacture of Illuminating Gas.

Before taking up the details of the Semet-Solvay plant a brief description will be given of the manufacture of illuminating gas and some of the advantages of electric drive for such establishments. Bituminous coal is the material from which the products of this industry are derived. Although one of the most important chemical industries of today, its inception dates but little before the beginning of the nineteenth century. From that time the manufacture and use of illuminating gas from soft coal has extended and expanded until it has reached its present enormous development.



Group of Gas-Engine Driven Generators.

The general principle of the manufacturer is exceedingly simple. Its commercial growth, however, has been assisted by the invention and application of a multitude of delicate and ingenious appliances. Gas is made in several types of furnaces, but all have the same principle. The



Large Generating Unit.

coal is placed in retorts of clay or steel and subjected to high temperature from a coal furnace or from gas flames. Suitable pipes are attached to the retorts to carry the gas to those other portions of the works which serve to perform upon the crude gases certain purifications such as the condensation of the condensable vapors and the removal of objectionable gases.

The operations spoken of show that the gas must be carried from one portion of the establishment to another. Illuminating gas is made up of material substances and although lighter than air, distinctly possesses weight. Gas will not move itself and mechanical appliances must be resorted to for the movement from one place to another. This is accomplished by an exhauster which consists essentially of two impellers geared together and revolving in an interlocking manner with the driving shaft connected to one impeller only. In characteristics and power requirements the exhauster is not dissimilar to a centrifugal pump and is well adapted to motor drive. On account of the inflammable nature of the gases handled by exhausters, induction motors lend themselves to this class of work, as any material sparking from a direct-current motor would be liable to ignite escaping gases. If the exhauster were not used there would be a constant tendency to the creation of pressure in the retorts.

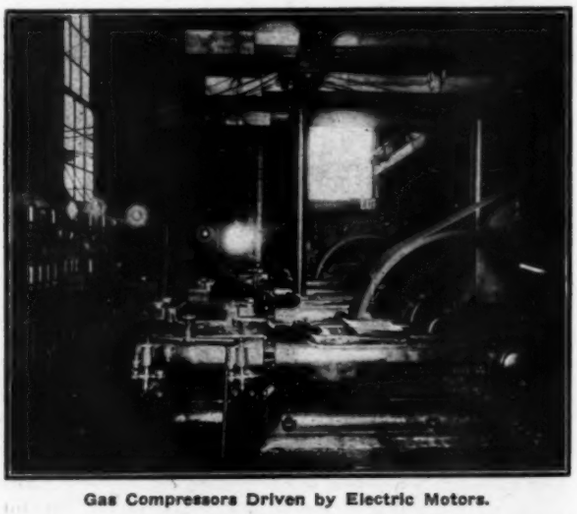
The essential parts of a gas works include furnaces; retorts in which the coal is heated; the hydraulic main; a trough in which the gas is cooled, and which also serves as a gate through which the gas can pass forward toward the purifiers, but not backward toward the retorts; condensers, in which the gas is cooled and some of its vapors are condensed to tarry liquids; scrubber, in which the gas is cleansed by a spray of water; purifiers, where sulphuretted hydrogen, and some other objectionable gases are removed; the gas holder, in which the finished gas is stored.

For the first operation a suitable quantity of soft coal is placed in the retorts and streams out of the openings. The openings are then quickly closed and the gas passes up the dip-pipe into the hydraulic main, bubbling up from this pipe through the water. Once delivered in the hydraulic main, the gas cannot go back to the retort. The gas next passes through the condensers, which consist of a series of pipes. The condenser cools the gas so that it deposits tarry liquids which have been suspended in the form of vapor until this stage. The gas next flows to a scrubber which may be built in a number of styles. Its essential office is to wash the gas and it does so by the use of water, which is applied to the gas in sprays or in thin films. Ammonia gas is the principal substance absorbed by the water in the scrubber and the liquid thus produced is the principal source of ammonia and its compounds. The gas next goes to purifiers containing dry quicklime which absorbs sulphuretted hydrogen and some other acid gases. From the purifiers the gas passes to the holder.

Equipment of Semet-Solvay Plant.

At the Semet-Solvay plant there are 46 coke ovens and the coke chambers or retorts are approximately 35 feet by 7.5 feet by 16.5 inches. There are five flues built in the walls of the horizontal ovens. The gas returned from the condensing house is burned in four burners and mixes with preheated air from beneath the ovens. The path of the gases is from the top flue downward through the remaining flues passing the fresh gas burning at each burner. The gases pass into a single flue beneath each coking chamber, which are provided with thin walls, thence to an underground flue to the boilers in a separate building. From seven to nine tons of coal can be coked in each oven every 24 hours. After completion of coking process the charge is removed by an electrically operated pusher or ram, which pushes the whole charge out of the opposite side through doors in the ends of the retorts which are closed and luted with fire clay during the coking process. The coke is then rapidly cooled by a stream of water.

The waste-gas flue extends into the boiler house beneath the floor surface and in front of three of the boilers. There is a fourth boiler which is hand-fired for use during the time of peak loads. The waste-heat boilers comprise two Abendroth & Root water-tube units, rebuilt by Babcock & Wilcox, each rated at 250 horsepower, and an Altman & Taylor water-tube boiler of the same rating equipped with 162 18-foot tubes. The hand-fired boiler is rated at 130 horsepower and is of the fire-tube type. The normal path of the waste gases is from the waste-gas flue to the fire boxes, through the boilers and breeching, and thence to the stack. The temperature of the flue gases ranges from 500 to 700 degrees Fahrenheit. There is a by-pass connecting the waste-gas flue directly with the stack. Each

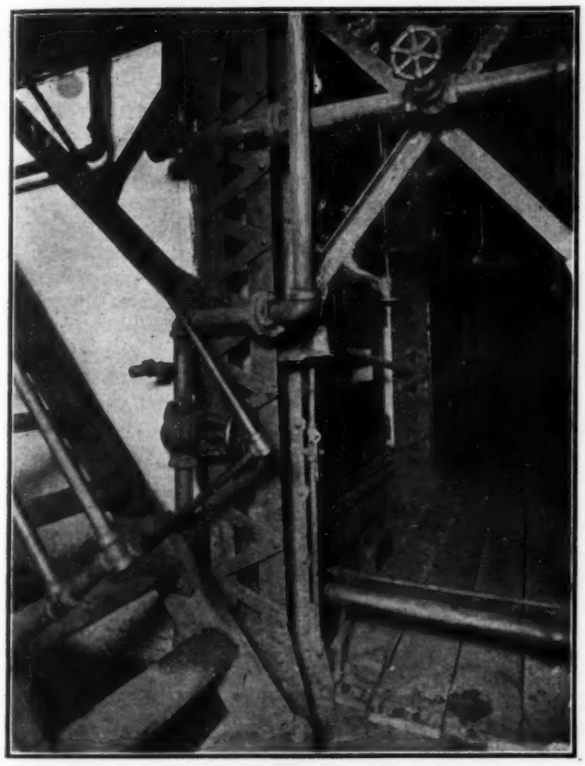


Gas Compressors Driven by Electric Motors.

waste heat unit and the by-pass to the stack can be shut off by means of water-cooled dampers which are lowered in place by means of a hand-operated crane. The dampers consist of steel plates approximately seven feet square, with pipe coils between them. The coils are connected to a source of water supply and to a sewer connection by means of flexible-hose couplings. When the boilers are

not in use all of the gases pass through the by-pass to the stack, or when there is a surplus of heated gases the by-pass can be used to convey a portion of the gases through the stack to the atmosphere. The boiler feed pumps, the feed-water heaters and the water purifiers are located in a separate building where are also located the steam-driven exhausters and some of the other necessary auxiliary apparatus.

To purify the gas for use in the gas-engine generating plant there are several auxiliaries, including the primary and secondary condensers, tar extractor, scrubbers, washer and purifier. The gas from the ovens passes from the retorts to a common main and thence to the first condenser and so on through the various devices. The exhausters operate to maintain a constant pressure in the retorts and to furnish the necessary pressure to overcome the resistance of the purifying apparatus and to force the gas into the holder. The exhausters are driven by steam engines which utilize steam derived from the waste-heat boiler equipment.



View of Waste-Heat Boilers.

Electrical Equipment.

The gas-engine generating plant carries the lighting load and furnishes energy for a large number of motors. The electrically driven rams for discharging the retorts are two in number and operate on trucks which run on a track extending the length of the tier of ovens. They are operated by series-wound motors. In addition there are motors for operating miscellaneous pumps, crushers, car hoists, etc.

The gas-engine plant is located in a one-story concrete building where are also located the compressors for furnishing pressure to the gas. The engine room proper is divided into two sections. One part is on the ground level and contains a two-unit Alberger tandem gas engine, each unit consisting of a size-17 engine operating at 215 revolutions per minute. Mounted on the common shaft there is a Crocker-Wheeler 200-kilowatt, 250-volt, 800-ampere, direct-current generator. In the second part of the engine room, which is elevated several feet above the first, there are three generating units, a Westinghouse, 11-by-12-inch, vertical, three-cylinder gas engine direct-connected to an engine-type 75-kilowatt, 250-volt, 300-ampere, direct-current generator, operating at 365 revolutions per minute, and two Buffalo, size-17, tandem gas engines, each driving an engine-type 100-kilowatt, 250-volt, direct-current generator, operating at 215 revolutions per minute. There is a marble panel switchboard, with the necessary generator and feeder switches and instruments.

For forcing the gas sold commercially under the proper pressure, there is an equipment of two 14-by-12-inch Ingersoll-Rand compressors belt driven by two Westinghouse 50-horsepower direct-current motors. The motors are located on a platform above the compressors and are belted to a countershaft which in turn drives the compressors. The motors are variable speed, one rated at from 350 to 1,000 revolutions per minute, and the other from 500 to 1,000 revolutions per minute. The motors are started by automatic switches and the speed is varied by motor-operated field rheostats. The scheme of the motor connections is as follows: In starting, the solenoids of the automatic switches are operated from an auxiliary circuit by closing the main switch. First one solenoid draws up the core, closing the motor circuit through a resistance, at the same time energizing the second solenoid, whose contacts cut out one section of the starting resistance, and so on, until the motor has accelerated to normal speed. The speed is varied to change the pressure of the gas in the compressors by the motor-operated field rheostats.

In addition to the compressors in this room there is an 800-gallon-per-minute Goulds triplex pump belted to a 50-horsepower motor. The gas is metered by a Venturi meter which has the advantage of occupying much less room than most other types.

Third National Safety Exposition to be Held in New York, May 22-27.

Preparations are nearly complete for the opening of the third National Exposition of Safety and Sanitation in New York City in May. This promises to be the largest safety exposition ever held as well as the most comprehensive single effort to bring together under one roof the thousand and one things that make for greater safety in industry, the street, the home and in the daily life of every one. It will be held under the auspices of The American Museum of Safety and will open its doors on May 22 running through May 27.

"The Safety Exposition has become a permanent institution in our country," says President Arthur Williams, of The American Museum of Safety. "The splendid results shown by the previous Safety Expositions have demonstrated that a much greater interest in safety and sanitation was aroused. It is a lasting incentive to safety endeavors. Under the stress of competition offered by the Exposition, improvements are sought and put into practice, inventions made, new methods devised, greater care taken and new standards set. After all, preparedness in America should begin in our industries; keeping our workingmen fit and whole and sound, the men who will have to do the defending when the time for defense comes, is of the greatest importance. Half a million is a conservative estimate of the workers maimed in American industries every year. These half million cripples would otherwise constitute a formidable army. At the coming Safety Exposition there will be something of vital interest for everyone from the president of an industry to the man who wears overalls, from the housewife to the woman who works in the store, factory or office, and from the college student to the child in grammar school."

Alternating-Current Submarine Telegraphy

Details of an Important Advance in Submarine Telegraphic Communication with Uninterruped Alternating Current As Developed by Col. George O. Squier

In a paper presented to The Physical Society of London last year, George O. Squier, United States military attache at London, analyzed the conditions to be met in submarine telegraphy and described apparatus for operating on the principles proposed. Experiments had been conducted for two years to determine the practical application of a sine wave in cable signaling.

If an engineer were required to design a system for operating an electric motor through an Atlantic cable, no form of generator could be proposed at present other than a single-phase alternating current of the sine-wave type. This form will deliver power at the receiving end of the cable more efficiently than any other shape of wave. During the operation of such a motor, the generator would be allowed to run smoothly and regularly, and the generator circuit would never be metallically opened or closed during operation. The opening and closing of an alternating-current circuit is well known to produce disturbances of a more or less pronounced character, depending upon the angle of phase at which the current is opened or closed.

Since improvement of the duplex-bridge balance is really at present a most important desideratum, experiments were made using the Muirhead artificial cable to compare the present forms of battery transmitters with various modifications of the sine wave of electromotive force.

In the last analysis it was always the opening and closing of the transmitter circuit which produced the final kick or "jar" in the balance. This is not surprising when we remember that, from an electrical standpoint, few things can be done to a circuit more severe than suddenly to introduce an infinite resistance into it.

It was only after many variations of the simple alternating current had been tried in the course of experiments to perfect the duplex-balance of the bridge that the fundamental principle of never breaking the transmitter circuit became impressed.

Continuing the analogy of the power plant, it may be remarked that practically every form of cable recorder, amplifier or relay is essentially an alternating-current motor. Its field magnet, armature coil, and the counter electromotive force of damping are subject to the same laws as in the motor for power purposes.

Let us assume, therefore, as a starting point, the standard type of circuit for operating a cable simply as a power plant as the ideal solution of the problem, and then determine by experiment how near this solution may be retained in practice for the purpose of transmitting cable signals according to the present alphabet. In this plan it will be the continued experimental purpose to determine the minimum possible variations in such a system to enable the alternating current received to be interpreted into dots, dashes and spaces.

A siphon recorder placed in the receiving end of such a cable plant would trace on the recording slip an uninterrupted sine wave of current which may be considered as the theoretically perfect form of siphon record always to be aimed at, although never to be actually attained in practical telegraphy.

In Fig. 1, D represents a single-phase alternating-current dynamo, R and R′ are resistances and M′ is a motor to be operated.

Since a circuit comprising an ocean cable is largely overloaded with capacity, and already includes a large ohmic resistance, it will be in the direction of increasing the resultant harmonic current flowing in such a circuit, to insert in the sending end of the cable a variable inductance, L_1. For symmetry, L′ is a variable inductance similar to L_1.

T and T′ are iron-cored transformers or auto-transformers, the coils of which are of low resistance, and connected directly to the earth at E and E′.

The circuits in Fig. 1 are closed circuits throughout.

For duplex working Fig. 1 becomes Fig. 2, in which L_1, L_2, L_3, L_4 are the inductance arms of the bridge, and the motors M and M′ are inserted in the usual manner for cable working; Al and Al′ are the artificial lines.

It now remains to inquire as to what modifications must be made in the typical duplex power circuit in Fig. 2 to enable the motor recorders to indicate the elements of the cable alphabet. These elements are three in number, and only three—the dot, the dash and the space—and each of them is equally important in interpreting the record, and for this reason they will each be considered in the general sense as signal units, rather than the usual way of regarding only the dots and dashes as the signals, and not the spaces.

Careful experiments on an Atlantic cable confirm the theory of the subject—that, no matter what the shape of the alternating current transmitted, approximate sine waves are received at the distant end of the cable. Battery reversals produce just as accurate sine-wave signals on the receiving record as does the alternator itself. In other words, it is the fundamental term of the Fourier analysis which is alone concerned in making the record at the receiving end of the cable.

Since, therefore, both theory and experiment show that a sine form of wave is the only one which can pass through the cable without changing its characteristic shape, it should be an advantage so to alter the typical power circuit in Fig. 2 as to preserve the sine characteristic as far as possible.

This can be done in a simple manner by operating upon the primary circuit of the transmitter containing the generator, to alter the impedance of the circuit in synchronism with the generator itself. The problem is the more simple from the practical standpoint, because we are dealing with frequencies from about 4 to 10 cycles per second, and, therefore, it is easy to operate with great accuracy on this primary current at any angle of phase. If the change of impedance of the primary circuit always takes place at the instants when the current flowing in the circuit is naturally zero, the fundamental frequency of the current will not be changed, and the sine characteristic of the wave will be very approximately maintained. Varying the impedance of the primary circuit will change the amplitude of the individual alternations of the current.

Fig. 1.—Simplex Circuit for Ocean Cable Considered as a Power Line.

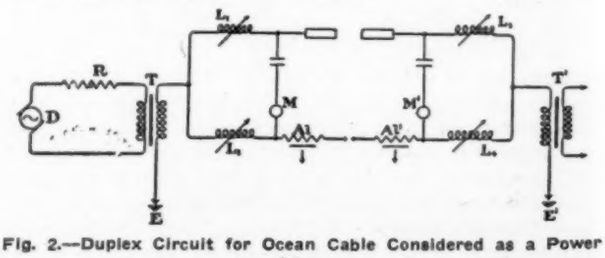


Fig. 2.—Duplex Circuit for Ocean Cable Considered as a Power Line.

Another way of stating the effect is that the voltage between the end of the cable and the earth is made to vary by this process, to indicate the three elements of the cable alphabet. It should be noted that this plan transmits alternating current for the spaces between letters and words with exactly the same regularity and integrity as for the signals themselves.

Dots, dashes and spaces are each transmitted by impulses of either sign, differing from each other only in amplitude.

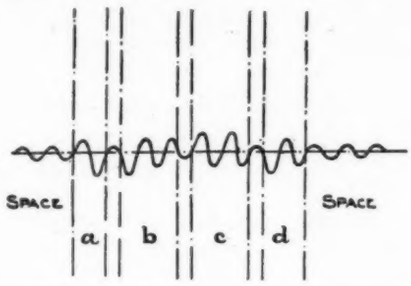


Fig. 3.—Current Waves for Transmitting the Letters a, b, c and d by Alternating Current.

Fig. 3 shows diagrammatically the form of current waves transmitted for the letters *a, b, c,* and *d,* with the accompanying spaces required.

Although an alternating current operated upon as above outlined could be read directly from a standard siphon record, yet it would be considered an advantage if the final received record could be printed in Morse characters on the usual receiver slip. To accomplish this it will be necessary to provide an apparatus which operates solely by the amplitude of the current waves received, and not by their sign. Furthermore, since the impulses transmitted and received for the spaces are not required on the printed slip, the apparatus should be capable of sorting out and omitting these parts of the record automatically.

Description of Circuits Used.

Fig. 4 shows diagrammatically one form of circuit arrangement based on the above principles for transmitting and receiving messages. The usual transmitting condensers are shown in the arms of the duplex bridge, instead of the inductances L_1, L_2, L_3, L_4. The ordinary transmitting tape is caused to move synchronously with the generator by being geared directly to its armature shaft. The perforations in the tape are of such a size that the tape advances a distance corresponding to one semi-cycle of the alternator for each individual perforation.

Since in a circuit comprising an ocean cable on which is impressed an alternating electromotive force the current leads the electromotive force by an angle, which in an infinite cable is constant at 45°, it is necessary to provide in the transmitter mechanism for moving the tape carriage longitudinally relative to the perforations in the tape. A micrometer screw is provided for this purpose, and by its use the current can be operated upon accurately at any angle of its phase, and in practice it is so adjusted that the impedance of the primary circuit will be changed at the instants of zero phase of the current. Since also the angle by which the current leads the electromotive force is dependent upon the resistance of the primary circuit, there is provided in addition an adjustment of the transmitter for the very slight difference of phase for the dot-and-dash conditions, so that in effect all operations on the primary current, whether for a dot, dash or space, are adjusted to take place at the zero point of current.

The general operation of the transmitter mechanism is as follows. When no holes are perforated in the tape *t,* the whole resistance R is in the primary circuit and an alternating current is transmitted, which corresponds to spaces between letters and words; when a perforation in the tape is on the dot side, part of this resistance R is short-circuited, and when a dash perforation occurs, all of this resistance is short-circuited. The relative values of these resistances being adjustable, the amplitudes of the individual alternations are under complete control by the ordinary transmitting tape.

In the figure is shown diagrammatically the arrangement for causing a dash impulse to be sent by the transmitter by short-circuiting the whole of the resistance R for a time corresponding to one semi-cycle of the alternator. *r* is an ordinary relay; *k* is an electromagnet which operates at the end of each signal or group of signals. The line *l* leads to an exactly similar arrangement which is provided for the dot impulse by which a certain proportion of the resistance R is short-circuited. In practice these two arrangements are side by side, and in the figure the dot arrangement would be immediately behind the one shown for the dash.

The tape carriage can be moved longitudinally by a micrometer screw which is not shown in the figure, and has an adjustment over a range of a complete semi-cycle. The contacts *s* and *s'*, and similar ones for the dot mechanism, are adjustable by slow-motion screws, so that the instants of contact for a dot and for a dash have an adjustment relatively to each other.

A convenient method of observing the wave-form produced by the transmitter, and for making the above adjustments, is to include an ordinary siphon recorder in the transmitter circuit, or, better, in the cable itself at the transmitting end, by connecting it at the terminals of a very low resistance in the circuit. At the very low frequencies involved, the siphon recorder becomes a most useful and accurate current curve-tracer, and enables the experimenter to observe exactly the shape of wave being transmitted into the cable for any adjustment of the transmitter. Once these adjustments are made for any particular cable they remain unchanged.

Form of Receiving Circuits.

One practical arrangement for receiving the signals on a Morse printer is shown diagrammatically in the upper part of Fig. 4. F is an adaptation of the well known Muirhead gold-wire cable relay, in which f^1 is the gold wire which oscillates between the platinum contact posts f^2f^3, about a fixed point at F. A second pair of posts f^4f^5 is provided, and each of these pairs has an adjustment for altering their distance apart, and also for moving them longitudinally along the gold wire, and relatively to each other. Instead of being separate contacts, as in the usual case with this relay, each of the pairs are electrically connected as shown. F' is a local wire relay of similar principle, and *f'* is its moving part which in its oscillations makes contact with the posts f^4f^4 adjustable as above; *h* and *h'* are electromagnets for operating the dot and dash arms of the

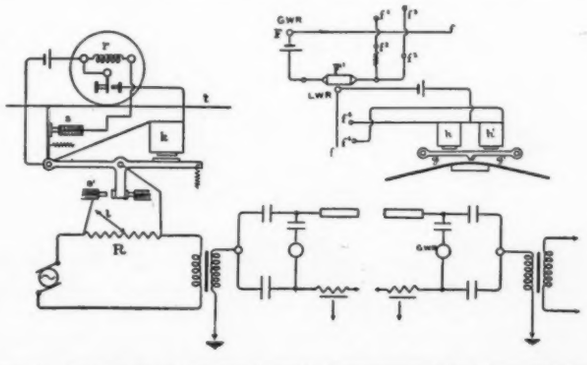


Fig. 4.—One Form of Duplex Circuit Arrangement for Transmitting and Receiving Messages by Alternating Current.

printer; *g* and *g'* are two arms pivoted at their outer ends, adapted to make a siphon record at their free ends in the center upon the moving tape shown beneath. The arm *g'* is forked to record two ink marks on the tape symmetrically on either side of the central mark made by the arm *g,* and in line with it across the tape, so that both arms can make a record simultaneously on the tape for a dash.

The incoming alternating current thus causes the gold wire *f*

to oscillate back and forth with different amplitudes depending upon whether dots, dashes or spaces are being received, and the posts f^2f^2 are adjusted so that the space amplitude just does *not* make contact, but does make contact for a dot amplitude of either sign. In like manner the posts f^1f^1 are adjusted so as just *not* to record a dot impulse, but to make contact for the larger amplitude of a dash of either sign. It is seen that both a dot and a dash contact are made whenever a dash ampltitude is received. The flexible gold wire f in its motions about F first strikes the posts f^2f^2, and there is a bending or wrapping effect produced in the wire, which for the stronger dash impulses causes contacts with f^1f^1 also. The relay F' operates similarly through a moving arm, making contact with the posts f^1f^1 separately or both together, depending upon the amplitude of its swing.

The printer itself becomes an apparatus of marked simplicity, and is nothing more than two small siphons adapted to mark on the slip in the usual manner. Fig. 5 shows the record produced.

In practice, all adjustments are so made as to provide for transmitting for the spaces as large an amplitude as possible instead of as small an amplitude as possible, in order to approximate more nearly to the ideal electrical conditions for transmission through the cable itself.

In case a cable magnifier such as the Heurtley instrument is used instead of a gold-wire relay, it would be inserted in Fig. 4 in the recorder arm of the bridge, and operate a local wire relay and printer instead of the usual recorder. Since the relay operates on difference of amplitude of the waves, and not on their absolute value, a cable magnifier would serve to exalt the value of this difference and furnish a greater margin for practical working.

Resolving Power or Definition.

The ideal alphabet to employ in cable signalling would be one in which other things being equal, each letter had the same limit of legibility; because if this is not so, the speed of signalling is lowered to meet the legibility of certain letters only. In present cable practice, what may be called the "resolving power," or the definition, is not equal throughout the letters of the alphabet.

Letters like *a* or *n*, for instance, may be considered as perfect letters, and whether sent by one complete cycle of electromotive force of a dynamo, or by two square-topped waves of equal area and opposite sign separated by a time interval, produce on the siphon record approximate sine waves. On the other hand, letters like *s* or *h*, where three or four square-topped waves of the same sign are sent into the cable consecutively, the received record at high speed fails to resolve these separate impulses, and the siphon record becomes a more or less con-

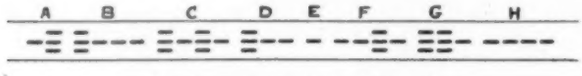


Fig. 5.—Reproduction of Record.

tinuous hump of large amplitude, which the expert operator learns to read without being able to detect the individual impulses; in fact, some practical operators seem to prefer these letters to what are known as "cross-letters" such as *a* and *n*.

Careful experiments have been conducted through long cables, which prove, however, that the so-called cross-letters have a superior legibility, which obviously should be the case from theoretical considerations only.

We may consider the siphon record of an uninterrupted alternating current as possessing 100-per-cent definition, independent of the frequency, the voltage employed, or the particular cable used, and regard it as the standard of definition for all signals. Indeed, such a record is, in fact, a message composed of a series of the letter *a* joined together without spaces between.

In present practice it is found necessary to insert a receiving condenser in series with the recorder coil, or an inductive shunt around the coil, for the purpose of improving the definition of certain letters of the alphabet, such as *s* and *h*, as well as to eliminate from the record the effects of earth currents of very low frequency induced in the cable.

Electrical Stress Upon the Cable.

Submarine cables are at present operated by primary batteries giving an open-circuit voltage of from 50 to 80. The main reason for this is, of course, the constant fear of subjecting the cable itself to undue electrical strain, particularly in the deep-sea portion, where repair is difficult and expensive. This is not the only reason, however, although it is the principal one.

The present form of battery transmitter impresses upon the cable square-topped waves, which may be analyzed by Fourier's method, and in the hands of Malcolm and a few others the wave-form has been worked out and predicted as the wave passed through the cable to the receiving end. Since we know that it is only the fundamental term of the Fourier analysis which produces an appreciable effect at the receiving end, all of the harmonic waves which are required to build up the square-topped form of wave are impressed upon the cable at the transmitting end, and are absorbed in the cable itself, and never reach the receiving end. These, therefore, represent superfluous electrical charge impressed upon the cable, and this charge for each signal must be got rid of before the succeeding signal can be sent into the cable.

It is, therefore, probable that a practical limit would soon be reached in the present form of transmitter, where the magnitude of this extra charge sent into the cable would become so great that there would be little advantage in further increasing the electromotive force.

The Cable Dynamo.

The alternator has been designed for the particular purpose of operating a cable, and possesses some novel features. Since we cannot reduce the number of poles to less than two, we must rely on a high magnetomotive force, and a minimum clearance for the armature to produce, at such low frequencies, the voltage required.

In addition, it is especially desirable to generate an accurate sine wave of electromotive force. These objects have been satisfactorily obtained in the design of the machine used in these experiments.

The resistance of each of the field coils is nearly 1,000 ohms, and the inductance of the armature largely controls the current in the armature circuit, so that the machine can be short-circuited at full voltage without harm.

In starting and stopping the dynamo no form of switch is used, but, instead, the motor which operates the dynamo, starting from rest, gradually builds up the electromotive force from zero, which gradually dies down to zero at stopping. In this manner there is never any possibility of a "break" in any metallic circuit connected with the transmitting apparatus.

Since the dynamo transmitter comprises the power plant for an ocean cable, it must, therefore, take its place on the instrument table, where the transmitter is directly geared to it. The armature is mounted on ball bearings, and runs with remarkable silence and smoothness under load.

It has been truly said that "we begin to understand a phenomenon when we can measure it."

It is seen that once we can employ a system of signalling in which we are dealing with one fundamental frequency only, and the circuit is never broken, the process of measuring the constants of the cable itself and the most suitable bridge arrangements for high efficiency are greatly simplified.

The removal of any form of arc or spark from the cable circuit has been shown to very materially increase the accuracy of balancing the duplex bridge, while the smooth type of waves employed in sending the signals has enabled this important object to be attained with an accuracy greater than has been possible before.

COMMERCIAL PRACTICE

New-Business Methods, Policies, Rates and Kindred Central-Station Matters for the Man Engaged in Selling Electricity

Street Lighting Contract on Kilowatt-Hour Basis for Spencer, Mass.

The town of Spencer, Mass., recently entered into a three-year contract with the Spencer Gas Company for the electric lighting of its streets on a schedule of prices which is somewhat of an innovation in central-station practice, that of a flat rate per kilowatt-hour, with a guaranteed minimum consumption per unit. The company supplies 220 60-candlepower (47 watt) and 50 80-candlepower (60 watt) type C street series lamps, the fixtures furnished by the company and the lamps, after the initial installation, by the town.

The rate paid is 14 cents per kilowatt-hour for the following number of kilowatt-hours as the monthly minimum consumption:

	Minimum Kilowatt-hours per Fixture.
January	13.0
February	11.5
March	9.0
April	7.5
May	7.0
June	6.0
July	6.0
August	7.0
September	7.5
October	9.0
November	11.5
December	13.0
Total for the year	108.0

For electricity consumed during the month in excess of the above schedule, the town pays 6 cents per kilowatt-hour.

The plan was adopted as the result of a study and report by William Plattner, consulting engineer, Boston. It was pointed out that if the town desires to increase its lighting hours or the capacity of its lamps, it is able to do so without entering into a new contract.

Bessemer, Mich., and Garner, Iowa, have street lighting contracts on the kilowatt-hour price basis, both of which are reported to be satisfactory to both the municipality and the company.

The total annual cost of street lighting at Spencer, 2,800 hours per year, is $5,260.68, made up from Mr. Plattner's estimate as follows:

220 60-candlepower lamps @ 47 watts	28,840	
50 80-candlepower lamps @ 60 watts	8,400	
15 per cent line loss, leakage, etc	5,586	
	42,826 or	
29,160 kilowatt-hours @ 14 cents	$4,082.40	
13,666 kilowatt-hours @ 6 cents	819.96	
Total cost of electricity		$4,902.36
Estimated cost of lamps plus 10 per cent for breakage and handling		358.32
Total		$5,260.68

For 3,400 hours per year the cost will be as follows:

220 60-candlepower units	35,020	
50 80-candlepower units	10,200	
15 per cent line loss, etc	6,783	
	52,003 or	
29,160 kilowatt-hours @ 14 cents	$4,082.40	
22,843 kilowatt-hours @ 6 cents	1,370.58	
Total cost of electricity		$5,452.98
Cost of lamps plus 10 per cent		577.76
		$6,030.74

VALUE OF RESIDENTIAL BUSINESS TO THE CENTRAL STATION SHOWN.

Density of Small-Customer Business Fosters Good Will Between Company and Public.

The experiences of the Sandusky (O.) Gas & Electric Company in regard to small-residence business were outlined at the recent new-business convention at Springfield, O., in a paper by G. A. Lowther, from which the following data are taken. In considering the value of residential business to the central-station company, three main classifications are suggested: (1) The value for revenue; (2) The educational value; and (3) The value from the investor's standpoint.

The value of revenue consists of the value in dollars and cents. This varies very considerably in different locations and the individual revenue from each residence may seem small, but the total sum will be quite respectable. The residence revenue depends a great deal on the way the customer is started. If you can introduce heating devices when the residence is first connected, it will produce good revenue from the start. It is easier to do this than to try and build up the load later.

Many central stations have an idea that the only residences worth going after are the large ones in the best section of the city, but this is a mistake. Many of the smaller residences produce good revenue, and they are worth going after. Last year, the Sandusky Gas & Electric Company connected up a number of small cottages (mostly five and six rooms). The cost of wiring them was only a trifle over $30 each, and in most cases, this included fixtures and lamps.

When the company started to go after this business, the wiremen made sarcastic remarks about holding the shacks together with their wires—the linemen evidently thought it was waste of time and material to run services, and the metermen felt certain that they would not need to read the meters because they would never use more than the minimum (50 cents per month). A recent check of 100 of these cottages disclosed the fact that they were using an average of more than 16 kilowatt-hours each per month, and many were consuming more than 25 kilowatt-hours per month, some more than 30 kilowatt-hours per month.

These results are attributed to the fact that an electric iron was included with every wiring contract, so that they got started off all right.

In the case of residences which have been connected up for some time, it is very necessary to use means to build up the load, especially as the lighting load is constantly becoming less important. It is surprising how many such ways there are in which the residence load may be increased, in addition to the ordinary heating devices, vacuumn cleaners and other machines which are dependent on the use of small motors. There is the electric range and fireless cooker, which is making great headway, and the electric incubator for hatching chickens, and the further use of electric current in the poultry business. There are a large number of people in every community who have small poultry farms in their back yards, and it has been proved that the use of electric light in the chicken house on dark mornings greatly stimulates the production of eggs. One case recently reported from a Western state, claims an increase of 40 per cent.

Another point which must be remembered in considering the cash value of the residential business, is the fact that every new consumer means a new customer of electrical merchandise, appliances, lamps, etc., if the company handles such merchandise and sells it at a profit, it means a further source from such sales. If the company does not handle electrical merchandise it still means helping the local contractor or dealer in electrical supplies, and this means helping the whole business from the manufactufer downwards.

The Educational Value.

When a new residence customer is connected, it means the electrical education of a whole family.

It may be that it starts the head of the family thinking of ways to use electric service in his business, or it may be that it starts other members of the family thinking, along electric lines, and it may lead to the introduction of electric service in places where they work, and it nearly always leads to further electrical development in the neighborhood or among the friends of the family.

Most important of all, the children are brought up to regard the service as a necessity and not as a luxury, so that when they have houses of their own, they will never be without electric service.

Also, if the central station has a large number of residence customers who are getting good service it will promote a feeling of good will towards the company, which is a most important asset for the company when it needs friends, because those who are not using electric service will appreciate the work of the company, and they will often go out of their way to boost its business.

The Value from the Investor's Point of View.

It is almost always true that the central station which has a large residential load finds that it is considerably easier to get money from bankers and investors in public utility securities than that the central station which can only show a large power load.

The inference is that the residence load sticks no matter what happens, whereas the power load is uncertain, being dependent on business conditions and liable to be lost at any time. The residence load in a small city is much easier to handle than the commercial lighting load, the residence load coming on gradually and staying on until a late hour, and then dropping off gradually, whereas the commercial lighting load serving the stores and offices in a small city comes on abruptly and drops off abruptly, owing to the fact that the stores close at 5:30. This means creating an undesirable peak and therefore an extra investment in plant equipment which is not profitable. Not only is it an undesirable peak but it is a winter peak—and in the summer time it disappears as a load entirely.

For all these reasons it will pay central stations especially in the smaller cities, to devote more attention to developing the residential load. It costs very little for extra equipment, the poles, lines and transformers are usually there; it means only running an extra service and setting a meter.

Increase in Battery-Exchange Service in Boston.

Eleven more electric trucks, operated by six different firms, have recently been added to the Boston Edison Company's battery exchange service, of which Charles H. Miles is in charge. Six of the trucks are of 3.5-ton capacity each, and are to be operated by a contractor in street sprinkling and flushing and oiling for the City of Boston. The tanks for these purposes are to be removable and dumping bodies substituted for the collection of city ashes during the winter, the vehicles thus serving a double purpose.

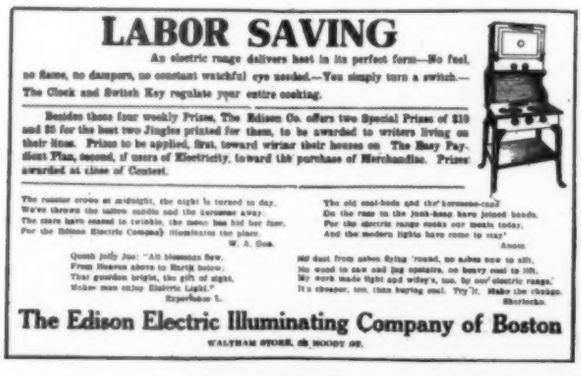
Other vehicles signed up for Edison service are four two-ton and one 1,000-pound wagons, which are owned by a metal-working concern, a spring water company, a Newton market-man, and a leading Boston coffee wholesaling house. The chassis are of General Vehicle Company manufacture, the batteries are the Exide Ironclad of the Electric Storage Battery Company of Philadelphia, and the charging, and in some cases the garaging, is provided by the Boston Edison Company at its Atlantic Avenue electric garage, the rates being based on mileage rather than on current furnished.

Northern States Power Service Extends to Two More Towns.

The Northern States Power Company has been granted franchises in the villages of West Concord and Pine Island, Minn., for electric service. A street-lighting contract has also been secured in the village of West Concord, which has a population of 800 and is situated about ten miles south of Kenyon, which is now served by the Faribault division of the Northern States Company. In addition 50 residence customers and about 50 horsepower in motors will be secured in this community. Pine Island has a population of 1,000, and is situated about seven miles from Zumbrota. Street-lighting revenue from this village will amount to $1,000 per year. Other business includes water pumping for the village water system and a considerable commercial and residential lighting load.

Returns from Central-Station Advertising in Waltham.

Advertisements of the Boston Edison Company occupy the central position in a special weekly advertising feature page of the Waltham (Mass.) *Evening News*. Each week the *News* awards $15 in prizes for the best rhymes in connection with each of the businesses utilizing advertising space, and the Edison company is favored with a liberal number of jingles which set forth the satisfaction its customers have found in Edison service. The electric range is a favorite theme for these rhymsters, but lighting, power, cleaning apparatus and other domestic uses come in for their share of laudation.


LABOR SAVING
An electric range delivers heat in its perfect form—No fuel, no flame, no dampers, no constant watchful eye needed.—You simply turn a switch.—The Clock and Switch Key regulate your entire cooking.
Besides these four weekly Prizes, The Edison Co. offers two Special Prizes of $10 and $5 for the best two Jingles printed for them, to be awarded to writers living on their lines. Prizes to be applied, first, toward wiring their houses on The Easy Payment Plan, second, if users of Electricity, toward the purchase of Merchandise. Prizes awarded at close of Contest.
The rooster crows at midnight, the night is turned to day.
We've thrown the tallow candle and the kerosene away.
The stars have ceased to twinkle, the moon has hid her face.
For the Edison Electric Company illuminates the place.
W. A. Gun.
Queen Jolly Joe: "All blessings flow.
From Heaven above to Hurig below.
Your gowden bright, the gift of sight,
Makes men enjoy Electric Light."
Experience 5.
The old coal-hods and the kerosene-can?
On the rear in the junk-heap have joined hands.
For the electric range cooks our meals today.
And the modern lights have come to stay'
Anon.
No dust from ashes flying 'round, no ashes now to sift.
No wood to saw and log upstairs, no heavy coal to lift.
No work made light and wifey's, too, by our electric range.
It's cheaper, too, than buying coal. Try'it. Make the change.
Sherlocks.
The Edison Electric Illuminating Company of Boston
WALTHAM STORE, 28 MOODY ST.

The Electric Cooking Range is the Best and Cheapest to use. If we did not believe so we would not claim it. We depend for our success upon the confidence and good will of our customers.
50 Styles From $25 up
The junk man has our Cooking Stove, the Poker, Hod and Sifter.
We have in Edison Range in now, it's cheaper, easier, swifter.
For up to date efficiency, there's nothing that can match it.
Goodbye to ashes, coal and wood, the chopping block and hatchet.
Cyrus T.
Little things called matches can't be found at night.
But the Edison burner flashes out the light.
Little specks called coal-dust soil the clothes and hand.
Little range called Edison cooks to beat the band.
Ralph Waldo.
Your COOKING can be done with ease, your HEATING in a way to please.
Your CLEANING without dirt or dust, your LIGHTING too you can adjust,
If you'll but listen to my lay, and learn about the EDISON WAY
Just phone and they'll be glad to come, and soon explain how it is done.
Alanfa.
Demonstrations are free to all
At EDISON'S store whenever you call.
We'll surely make your call a pleasure
By showing you goods that will give you more leisure.
7-20-4.
The Edison Electric Illuminating Company of Boston
WALTHAM STORE, 28 MOODY ST.

Two Advertisements Used with Success by Boston Edison Company in Range Campaign.

ELECTRIC VEHICLES

A SAFETY DEVICE FOR ELECTRIC VEHICLES.

By H. E. Ackerly.

Despite the care exercised by trained drivers, the switch on an electric truck is occasionally thrown in while the controller

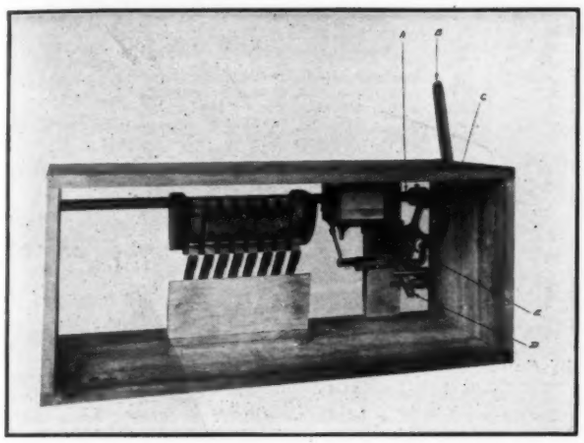


Fig. 1.—Main Switch Open and Pawl Disengaged.

is off the neutral point. This act has caused not only property damage, but frequently personal injuries and occasionally death.

The fact that this accident hazard existed led the Eastman Kodak Company, which operates a fleet of electric trucks, to develop a safety device to prevent such an accident. The mechanical engineering department of the Kodak company has just completed the installation of the device on its trucks. With this mechanism, the switch cannot be operated when the controller is off the neutral point. The device has not been patented, as the designers wished any one caring to do so to take advantage of it, either in building new trucks or in equipping those now in use.

The accompanying illustrations show one of the devices mounted in a box similar to a driver's seat in the rough. The photographs are taken from the front. The driver sits at the

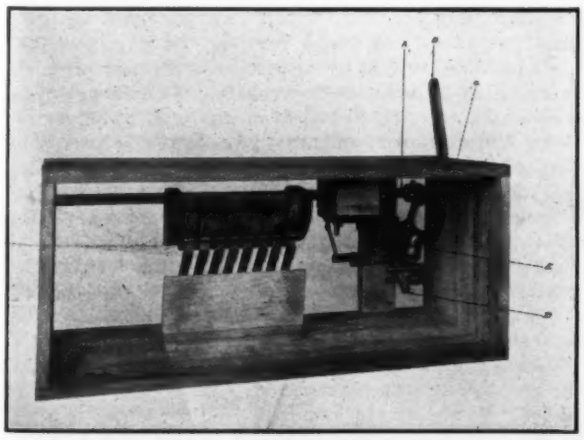


Fig. 2.—Main Switch Open, Switch Arm Partly Disengaged, Sector Not at Neutral Position.

left-hand side of the box, operating the control lever (B) shown in Fig. 1, with his left hand. The rheostat selector shaft (A), to which the controller lever (B) is attached, also carries a sector (C) which prevents the operator from engaging the switch except when the selector is at the neutral point. A lever (D) has been attached to the main switch from which the handle has been removed. This lever has a pawl (E). There is a slot in the sector (C) through which the pawl (E) on the lever actuating the switch must pass in order to close the switch. The sector (C) is so located that when the switch is closed, the rheostat selectors are all at the neutral point. As the pawl (E) is held forward by a pressure spring, the switch lever can disengage the switch at any position of the selector.

Electric Tractors in Lumber Mills Show Economy.

The Industrial Lumber Company has found that the three electric tractors they are now using have displaced 16 mules and 20 men, and are performing the same work with far greater efficiency. In addition they are affecting an unusualy large saving annually by the adoption of "electric mules." It is estimated that the total operating costs for 16 mules, including feed, shoeing, stable help, labor and repairs to tramways is approximately $22,890 per year. Operating expenses of the three tractors, including renewals of batteries (every year), renewals of tires(every year), renewals of chains, gears, etc., labor and repairs to tramways amount to $9,717. No current has been figured in the operating costs of the three tractors, as the amount used is not considered of any great consequence. Assuming that a mill were to buy current at four cents per kilowatt-hour the cost would not average $200 per tractor per year. The total cost per year of mule equipment, including the entire investment, fixed charges and operating costs, are $24,358. For the electric tractors the total costs are $11,115 per year. This shows a saving of $13,243 per year by using electric equipment.

The Electric Vehicle Association of America, which has for some time past been collecting data on the application of electric tractors in this field, has been informed that the Bodcaw Lumber Company, of Stamps, Ark., has recently given up animal haulage entirely for electric tractor equipment. This mill purchased three electrics about a year ago, displacing 15 mules and 15 drivers. They later found, however, that the same work could be done by two tractors, and they used the third tractor to haul finished lumber from the sheds to the cars, which had previously required 6 mules and 6 drivers. This makes a total of 21 mules and 21 drivers that are now being supplanted by the three electric tractors and three drivers and a helper. It is estimated that the expense for ownership, upkeep, depreciation, insurance and operation of one of these tractors when working a little less strenuously than the Bodcaw Mills work theirs, is approximately $6.00 per day or less, but crowded to its full capacity by performing the work of 7 mules, the cost increases to about $7.50 per day, as the Bodcaw people figure it. This company stated that there is little or no expense attached to the upkeep of the machines. It takes about ten minutes each day to oil them, and they are charged at night, which takes about four hours, and as the charging plant is automatically arranged, there is no necessity for employing a night mechanic.

The G. W. Gale Lumber Company, of Boston, Mass., has been using 5 electric lumber tractors for about three years, which are doing much more than the work of 40 horses which they previously used. The vice-president of this company has a problem that he occasionally propounds to his friends, and it is the result of the work of three electric tractors for 189 days, during which time the machines were driven 16,748 miles and carried 9,650,000 feet of lumber, that averaged 1.5 pounds to the square foot. He maintains that a horse can transport 15,000 square feet of lumber one mile a day, and he has asked his friends to determine how many horses would be necessary to accomplish the work of the tractors.

POWER ENGINEERING

Problems Involving Motor Applications, Machine Characteristics, Power Sales Methods and Industrial Electric Heating

CENTRAL-STATION POWER EFFECTS SAVING IN CANDY FACTORY.

Details of a Power Analysis Made by Toledo Company in Changing the Service.

By H. C. Riggs.

Some rather unusual circumstances were encountered in changing over and completing the central-station power installation of the Smith, Kirch Candy Company, at Toledo, O.

For reasons of expediency and betterment of the service, it was decided by the local power company to change over and discontinue all 500-volt street-railway power service. It was anticipated that there would be considerable expense to be borne by the company in accomplishing this desired end, but the new-business department took the matter in hand and in less than a year changed over practically every installation in the city without a cent of cost to the company, so far as the customers' end of the installation was concerned. Among the first changed over was that of the candy company in question.

This same matter had previously been broached to the customer by the company on several occasions, but in such a vague, apologetic manner as to lend weight to the belief that they wanted to "put something over" on the customer, and he had even refused to consider an offer to stand one-half of the cost.

In taking this matter up, the newer power sales organization, first stated the company purpose and position frankly. Several obvious general reasons were mentioned in support of the same, and permission was readily gained to make a survey or check up of the physical facts, so that the advantages to be gained by the customer from the change could be shown in definite form, as considered against the cost of making it.

The following is the survey made in detail:

Four electric service connections, contacts, and rates.

(1) 500-volt power for freight elevator.

(2) 500-volt power for general factory purposes.

(3) Single-phase, 60-cycle power for general lighting.

(4) Single-phase, 60-cycle power for electric chocolate melting.

The plant used a 40-horsepower Springfield gas engine to drive a 12-ton ammonia compressor, operating from 5:30 a. m. to 5:00 p. m. daily, March 1, to November 1; which was idle the other four months. This equipment was used for cooling packing rooms to 65 degrees Fahrenheit. Natural gas of 850 British thermal units was used, at 35 cents per 1,000 cubic feet. The engine was four years old, and frequently gave trouble by shut downs. The gas bills for the engine totaled $313.18 for the eight-months period. With electric power to replace, 35,357.5 kilowatt-hours would be required annually. There are about 100 lighting outlets at present, totalling five kilowatts connected load. The following conditions were found: poor installation of drop lights; some carbon lamps; open wiring, in bad shape, dirty lamps, no shades, etc.; motor installation only in fair condition; open wiring; not much motor or service trouble; application fair. The following was the motor installation:

Size, Horsepower.	Speed, R.P.M.	Drive.	Application.	Load Horsepower.
5	1,065	belted	Deep-well pump	4.15
5	1,065	group	Peanut roasters	3.5
2	1,190	group	Chocolate enrobers	1.43
2	1,190	belted	Mixing vats blower	1.4
5	1,200	group	Mixing vats	2.11
10	975	direct-connected	2,000-pound, 40-foot elevator	6.0
2	1,190	group	Candy rolls	1.03
5	1,065	belted	Mogul candy machine	2.06
10	880	group	Cream department	4.86
5	1,065	belted	Pulling machine	4.5
5	1,065	belted	Blower	3.8
56	11			

These motors were in salable condition.

The firm's ideas and desires were embodied in changes noted in part. The loads given were tests. In addition there is a five-kilowatt electric heating load, divided among 15 hand-dip chocolate tanks.

Operating records and costs for a year follow:

	General power Kilowatt-hours.	Elevator Kilowatt-hours.	Heating Kilowatt-hours.	Lighting Kilowatt-hours.
August	690	155	62	276
September	696	135	93	275
October	2,488	145	85	355
November	2,491	165	100	386
December	2,168	140	71	527
January	1,355	95	34	371
February	1,663	110	48	354
March	2,035	125	73	345
April	1,767	115	56	268
May	1,836	130	39	229
June	2,006	145	39	237
July	1,466	105	20	204
Total	20,661	1,565	720	3,827
Average	1,721¾	130.4	60	319
Cost	$564.66	$39.13	$42.32	$267.89

Grand totals, 26,773 kilowatt-hours; $914; average rate 3.41 cents. Overall, three-minute demand 13.6 kilowatts taken in November. Demand-factor 26.15 per cent of 52 kilowatts connected load. Load-factor, 17.3 for 8,760 hours per year. Load-factor, 73 per cent for 2,700 operating hours per year (nine hours per day, 300 days per year). Plant building, 80 feet by 120 feet, three stories and basement, 38,400 square feet floor space. The annual energy consumption for lighting per square foot of floor space is 0.1 kilowatt-hour and for power 0.59 kilowatt-hour, making a total consumption per year per square foot of floor space of 0.69 kilowatt-hour.

The factory was equipped with a private boiler plant, containing one 60-horsepower horizontal tubular boiler operating at 15 pounds pressure, used for building heat in season and for candy kettles, chocolate melting vats, spinning and warming tables the year round. The coal consumption amounted to 327 tons at $2.75 per ton delivered, or $899.25 annually. One licensed attendant at $75 per month was required. No other plant labor was needed. The state law required a licensed man in charge of boilers 30-horsepower and over, or carrying 30 pounds or more of steam, so it became apparent that no economies could be effected in this direction, and no further check was made.

The rated plant capacity is 10 tons of candy per day, the actual output, 5 tons per day average or 1,500 tons per year. This is 2.55 kilowatt-hours lighting per ton of output; 15.23 kilowatt-hours power per ton of output; or

a total consumption of 17.78 kilowatt-hours per ton of output. With the ice machine included, as previously determined, the figures revised are: 16.9 kilowatt-hours refrigeration power per ton of output; 32.14 kilowatt-hours total power per ton; and 34.68 kilowatt-hours overall per ton of output.

The analysis of this survey developed the following points:

Present demand	13.6 kilowatts
Ice-machine demand	13.5 kilowatts
Total	27.1 kilowatts
17 per cent diversity	4.6 kilowatts
Actual demand	22.5 kilowatts

This demand occurred in midsummer, instead of in midwinter. The winter demand would remain the same. The demand and load-factor on 70.75 kilowatts connected and 52,130.5 kilowatt-hours annual consumption, would be as follows:

31.8 per cent demand-factor.

26.4 per cent load-factor, 8,760 hours per year.

63.4 per cent load-factor, 3,654.5 operating hours. This increase in annual load-factor is 9.1 per cent.

A brief simple report was made to the candy company in the form of a one-page letter, detailing the consumption of energy and the cost of the same for a one-year period, on the existing rates and service connections, and adding thereto the various operating costs of the gas engine, which latter included the loss occasioned by shut downs. It was shown that at a new rate which was based on load-factor, and the blanketing of all energy used on one service then being purchased, would buy enough additional service at the new rate to operate the ice machine as required. The gas engine costs thus eliminated were sufficient to pay over 30 per cent on the cost of the improvement, constituting ample inducement, as it developed, to get the change made. It was also noticed that the improved drives and more efficient motors and installations, would easily result in an overall increase in efficiency of not less than 10 per cent. Co-operation in the broadest sense was given by the power sales department in writing specifications for the installation complete, closing the installation contract, and following the execution of the actual work, which was done with the factory in operation.

One unique drive was on the ice machine. The customer, with his past power failure on the engine in mind, decided to allow the gas engine to remain as emergency power for this important machine. The 25-horsepower slip-ring, high-torque motor was belted to a countershaft over the gas engine, so located that the drive belt to tne compressor could be rolled off of the overhung countershaft pulley, and the belt be the right length to roll onto the gas engine pulley. The gas engine is still dead and the motor on the job every day.

Another drive was replacing the 10-horsepower directly connected elevator motor and control. The nearest speed available in a high-resistance end-ring alternating-current elevator motor was about 100 revolutions faster, so an 11-horsepower motor was used to compensate for the increased travel speed. All the local elevator men backed down on the control which had to throw the double-throw starting switch, and operate the mechanical brake at the some time. This was accomplished by using a drum-type reversing switch with a U-grooved pulley on the shaft, of just the right size, to give the proper hand starting cable travel in throwing the switch out or in to set or release the brake at the same time. The two were interlocked on the one cable.

The first full month's operation with the complete new installation operative, showed 3,270 kilowatt-hours used.

Refrigeration Campaign in Philadelphia.

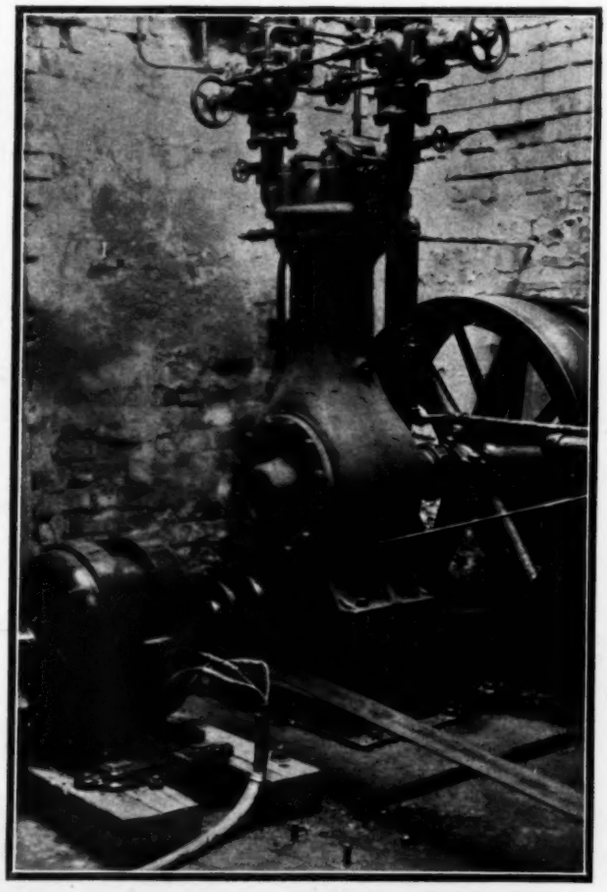
In a folder appropriately headed "Cold Facts," the Philadelphia (Pa.) Electric Company is presenting a number of advantages of electrical refrigeration for meat markets, florists, ice cream manufacturers and other establishments using ice. The advantages enumerated for electric process are:

(1) Lower and more consistent temperatures can be obtained; (2) a marked absence of dirt and all unsanitary conditions; (3) refrigerator air is kept dry because all water vapor is condensed on pipes as frost; (4) any desired temperature can be obtained and just as easily maintained; (5) show windows and cases can be readily connected, thus permitting the exhibition of perishable goods.

It is stated that while the saving in the cost of operating the small sizes of electric refrigerating machines may be slightly less, the main advantages are experienced in better conditions, both hygienic and in temperature. In the medium and large sizes, however, in addition to these advantages there is also a substantial saving in the cost of operation.

Power Company Anticipates Trouble with Gas-Engine Drive and Has Motor Ready.

A motor can be connected to practically any kind of a machine in some way, no matter whether the machine was put in to be driven by a motor or whether it was to be driven by some slow-speed machine. The illustration shows a 7.5-horsepower motor connected through a jack shaft to a small ammonia compressor used in a market. This compressor was driven by a gas engine for a long while. The Texas Power & Light Company knowing that trouble would result some day had a motor on hand ready and when the accident occurred the motor was installed on short order.



Ammonia Compressor Driven by a 7.5-Horsepower Motor. This Installation Made Few Hours After Failure of Gasoline Engine.

ELECTRICAL CONSTRUCTION

A Department Devoted to Problems Relating to the Installation, Operation and Maintenance of Electrical Equipment

ELECTRICAL INSTALLATION IN A LARGE MODERN CLUB HOUSE.

Wiring for Power, Lighting and Signaling Purposes in New Club House of South Shore Country Club, Chicago.

It is to be expected that the building of a large metropolitan club, with almost unlimited means back of the organization, will be very liberally equipped electrically. The installation of such equipment affords the electrical contractor unusual opportunities in work differing from the ordinary contracts for lighting and power in residences and industrial establishments.

The new building of the South Shore Country Club, whose electrical equipment is described in this article, is one of the imposing structures recently completed in Chicago. This club has a membership of about 2,000 members and owns a tract of ground about 65 acres in extent very favorably situated directly southeast of Jackson Park on the shore of Lake Michigan. The new club house, which was formally opened on January 20, occupies the site of the former building which was outgrown some time ago. The old club house was removed to the lake shore and is being equipped for a bath house, golf lockers and beach casino. The southeast wing of the old club house, which was used as a ballroom, was left in place, however, and remodeled so as to fit in with the new quarters. The new building is four stories in height and covers a ground area of about 90,000 square feet. The ballroom is the southeastern wing and the dining room the northwestern wing. Facing the northeast is another wing known as the solarium. The first floor of the structure is occupied by promenades, breakfast and card rooms, besides the main dining room, solarium and ballroom already referred to. The mezzanine floor has a number of offices, parlors, small meeting rooms, card rooms, etc. The two upper floors are occupied by special guests' rooms. All

Fig. 1.—View in the Solarium of the South Shore Country Club; Promenade and Main Entrance in the Background.

Fig. 2.—Power and Lighting Service Transformers.

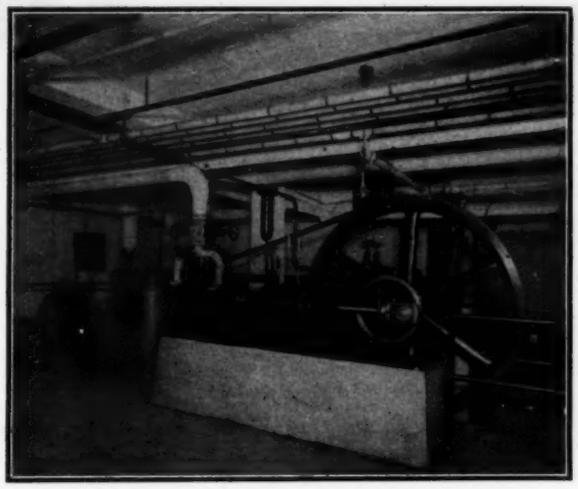


Fig. 3.—Electrically Driven Refrigerating Machine.

of the service equipment is in the basement. The building throughout is very artistically finished and decorated; particularly on the ground floor the principal rooms are very spacious and contain beautiful mural decorations and other luxurious furnishings to harmonize therewith. A good idea of the character of the interior is shown in Fig. 1, which is a view in the solarium, and also shows in the background the middle portion of the main promenade and the main entrance doorways. The cost of the new building was about $450,000.

Service Lines and Transformer Room.

All of the electricity used in the main club house and in the other buildings of the club is supplied by the Commonwealth Edison Company. To the main building this service is run in underground conduit, terminating in a specially built, fireproof, locked transformer room in the middle of the basement. The service enters as a 4,000-2,300-volt, four-wire, three-phase line whose entrance into the transformer room can be seen at the extreme right of Fig. 2. These cables are supported on an angle-iron framework and run over the two banks of transformers. Of these banks the one at the left consists of three 50-kilowatt General Electric transformers that are Y-connected on the primary side and step down from 2,300 volts to the 220-volt delta-connected secondaries. All of the power circuits in the building, from which these transformers are supplied, are 220-volt, three-phase circuits. The two transformers at the right are 50-kilowatt lighting transformers tapped in between one phase and the neutral and step down to 220-110-volt, three-wire lighting circuits. The primary cutouts for these transformers are clearly shown directly above the different units. The secondaries lead back from the transformers through the wall to the various cabinets to be described below. A heavy copper busbar connects the cases of all the transformers and is thoroughly grounded. Substantial grounding for the neutrals is also provided.

Main Service and Distributing Cabinets.

The secondary leads from the transformers terminate in special cabinets shown in Figs. 4 and 5. In the former view the first of these cabinets at the left is a distributing cabinet for the lighting circuits in the casino building located on the driveway between the entrance to the grounds and the main building; this cabinet also controls some circuits for special display lighting in the grounds. The cable running down in conduit from this cabinet connects to the casino building as an underground line. The second cabinet in Fig. 4 is the main service and distributing cabinet for the lighting circuits. The secondary cables from the lighting transformers enter the service switch at the bottom and from the top of this switch two heavy quadrupled cables pass to a junction box to the right, directly above which are two current transformers for the watthour meter. This measures all of the regular lighting load. From the meter the leads run back to the upper portion of the cabinet just referred to and from the busbars there shown the main lighting feeders are branched off to the various sections of the building. To the right

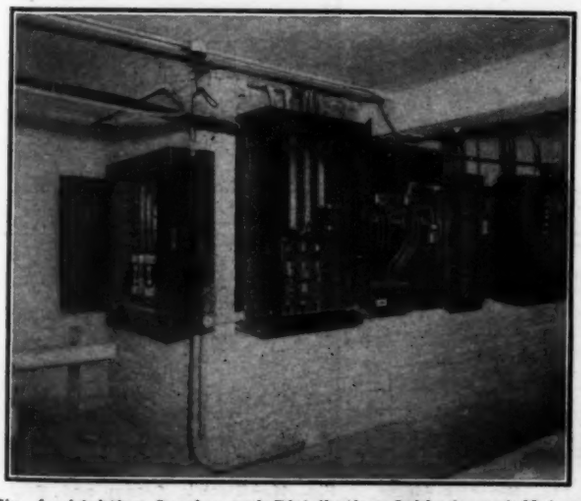


Fig. 4.—Lighting Service and Distributing Cabinets and Meters.

Fig. 5.—Power and Emergency-Lighting Cabinets and Meters.

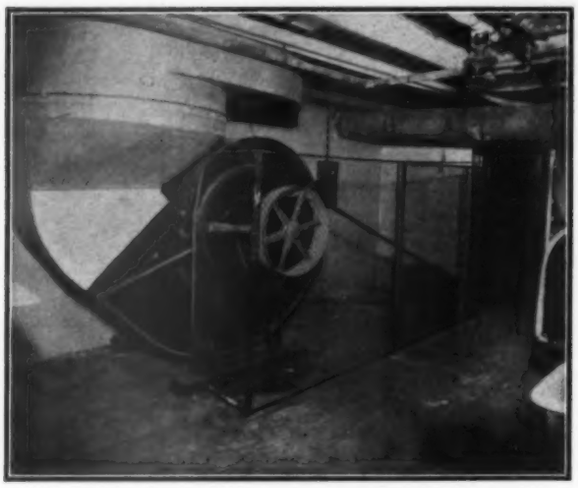


Fig. 6.—Large Motor-Driven Kitchen-Exhaust Fan.

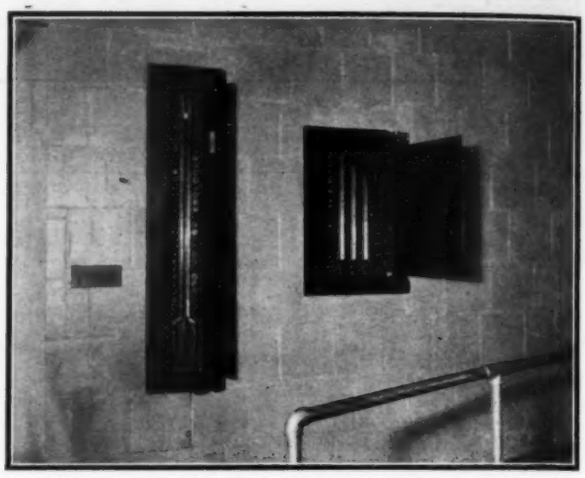


Fig. 7.—Typical Lighting and Power Cutout Cabinets.

of the watthour meter is the narrow high cabinet which controls part of the lighting circuits of the basement.

The cabinet shown prominently in Fig. 5, and rather indistinctly at the right edge of Fig. 4, is the main service and distributing cabinet for the power circuits. The manner of connecting the service switch directly from the secondaries of the power transformers, then through the current transformers and watthour meter and back to the distributing busbars in this cabinet is similar to that for the lighting circuits. In this case the demand indicator is shown to the left of the watthour meter.

Entirely distinct at the right of Fig. 5 is a separate cabinet for emergency lighting. This includes a simple double-pole service switch and connection to a separate meter. The circuits running from the emergency lighting cabinets are entirely distinct from the regular lighting circuits and are so distributed throughout the building as to provide a small number of lamps in each of the principal rooms and on all of the floors, thus taking care of the remote possibility of complete breakdown of the regular lighting circuits. All of the cabinets described are equipped with liberal wireways or gutters, and are provided with spring-hinge doors. When the photographs were taken these doors were especially held open to show the interior arrangement.

Engine and Pump Room.

As there is considerable need for refrigeration in the club house, a special refrigerating machine, electrically driven, has been installed. This is shown in Fig. 3. It is a carbon-dioxide compressor with cylinder 3.5 inches in diameter and 14-inch stroke. The carbon-dioxide system was used instead of an ammonia system on account of its greater safety in case of damage to any of the piping. This machine was furnished by the American Carbonic Machinery Company. It is belt-driven by a 25-horsepower, 220-volt, three-phase General Electric induction motor of the slip-ring type. At the time the photograph was taken the special secondary resistances for obtaining variable speed had not yet been installed, but they have since been put in near to the control cabinet shown directly above the motor.

As an auxiliary to this refrigerating set there is a centrifugal brine agitator or circulating pump which is driven by a two-horsepower motor. The brine from the refrigerating equipment is circulated in special piping to 16 refrigerators located principally in the main kitchen; the drinking water is also cooled and filtered, and there is also connected with the refrigerating system a large chamber in the kitchen for the cooling of plates and dishes on which ice cream and ices are to be served.

In this room there is also an electrically driven water supply and fire pump driven by a five-horsepower Jenney induction motor with automatic release circuit-breaker and float control. This supplies a large tank located in one of the elevator pent houses corresponding to the fifth floor of the building. The control for this is entirely automatic. This pump set is shown in Fig. 8. There are also in dif-

Fig. 8.—Electric House and Fire Pump.

Fig. 9.—Electric Sewage Pump.

Fig. 10.—Fire-Alarm Apparatus.

Fig. 11.—Electric Cream and Pastry Whipper.

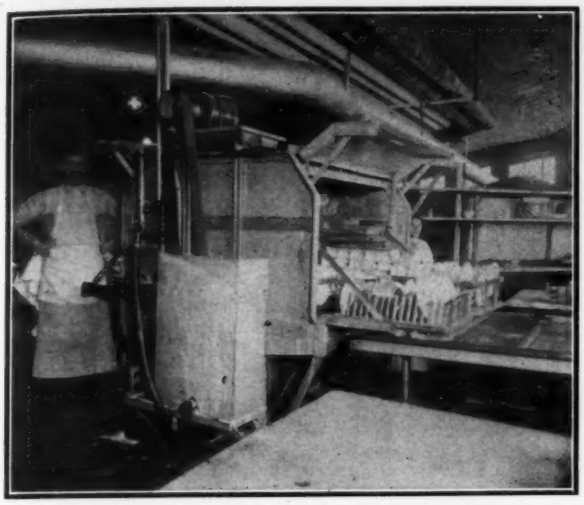


Fig. 12.—Electric Dish Washer in Main Kitchen.

Fig. 13.—Dish Washer in Auxiliary Kitchen.

ferent portions of the basement two sewage ejector pumps, which likewise are automatically controlled. One of these is shown in Fig. 9. This is a vertical pump mounted directly over the impeller which it drives. Since the club grounds are quite near the lake, it is necessary to use these pumps to raise the sewage from the sump to the higher level of the city sewer system. Three of these pumps are located in different portions of the grounds.

Just outside of the kitchen is a large ventilating set driven by a 7.5-horsepower induction motor. A view of this is shown in Fig. 6. It acts as an exhaust fan for the kitchen in general and has special flues running over the large ranges and other places where excessive heat or gases are found. There is also a small motor-driven ventilating set mounted over the center of the main dining room. The larger set referred to also has a duct connected with some wall registers in this dining room.

There are two electric elevators in the building, one for passenger service and the other for freight. These were installed by the Otis Elevator Company and are operated by the standard alternating-current control and motor equipment furnished by the company. The motors and controllers are installed in the pent houses over the respective shafts. These pent houses form an attractive cupola-like effect on the sky line of the building and serve to enhance its architectural appearance.

In the laundry of the club house there are installed two large electrically driven washing machines and a motor-driven mangle. Numerous electric flatirons are used in the tailoring and sewing rooms, for which special outlets are provided.

Electric Equipment in Kitchen.

The main kitchen, which is located directly below the main dining room, is provided with the most modern facilities for efficient and sanitary preparation of the food, and for washing the dishes returned from the dining room. Located in the kitchen proper are a number of electrically operated appliances, including a coffee grinder, meat chopper, potato peeler and a cream and pastry whipping machine. A view of the latter is shown in Fig. 11. The main dish washer in one corner of the kitchen is shown in Fig. 12. This is driven by a 0.5-horsepower motor and is of the Crescent type furnished by the Bromeley-Merseles Company, Chicago. This machine is the one in active use every day. Fig. 13 shows a special dish washer driven by a 0.5-horsepower motor. This is installed in an auxiliary or overflow kitchen, which is used when exceptionally large parties are to be served. This dish washer was furnished by G. S. Blakeslee & Company. The magnitude of the demands upon the entire kitchen equipment can be shown when it is stated that on one occasion 2,360 persons were fed in one evening.

As an auxiliary to the kitchen is a room in which there is installed an ice-cream freezer, an ice crusher, an ice-cubing machine and an ice shaver. All these four machines are driven from a line shaft, which in turn is operated by a two-horsepower motor. At the present time this motor is a single-phase Century induction motor, which was one of

Fig. 14.—Lighting Fixtures in Main Dining Room.

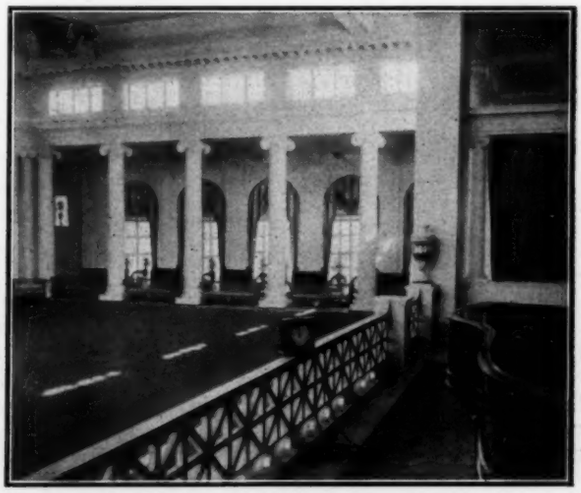


Fig. 15.—Operating Dial for Dance Announcer in Ball Room.

the machines retained from the old club house. It is expected, however, that a three-phase motor will be installed in place of this. These machines take care of the ice used for drinking water and such ice as is needed in the freezer and for other miscellaneous purposes.

Lighting Equipment.

Special pains were taken in the design and installation of all of the lighting equipment. Taking up the lights in that portion of the building just described, namely, the kitchen, mention must be made of the use of individual lamps housed in vaporproof fittings in the various refrigerators. Over the row of ranges in the kitchen there is also installed a long row of about 20 lamps mounted directly on conduit. These are placed in a hood above the ranges, the hood serving not only to carry off steam and vapors but also to screen the direct light of the lamps from the eyes of the chefs.

For the lighting of the main and other floors special consideration was given. In the case of the solarium shown in Fig. 1, it will be observed that conspicuous in the center of the picture is a large ornamental pedestal surmouned by an urn. Within this urn are four 500-watt lamps equipped with individual reflectors which provide for the indirect illumination of the beautiful ceiling of this room. By this arrangement the ceiling is left entirely unobstructed by fixtures so that its artistic design may be freely studied and appreciated. In the side wings of this room there are a few ceiling fixtures, but for the most part it is planned to use floor and table lamps, providing both direct and indirect illumination. For this purpose a considerable number of floor receptacles have been installed.

The main dining room is illuminated by means of two pendent crystal fixtures of very ornate design. These include a large number of small lamps. In the center of this room is another ornamental pedestal surmounted by an urn in which are six 500-watt lamps, providing indirect illumination for the center of the ceiling which has a special decorative pattern not very well shown in the view of the dining room in Fig. 14. In the main promenade running the full length of the building on the main floor there are also some very handsome fixtures, together with two equipments of the pedestal indirect type, these containing smaller lamps than in the solarium and dining room, however. In the ballroom the illumination is from the indirect fixtures that were originally installed when the old club house was completed.

The control cabinets for the lighting circuits are of special compact type, of which one is shown at the left of Fig. 7. These cabinets include a three-inch wiring pocket or gutter all around and in the back.

Signaling Circuits.

Installed throughout the main building is a special fire-alarm system comprising 10 boxes or stations. Each of these is equipped with an electromechanical gong which sounds when the box is pulled, at the same time indicating in the engine room where this system centers. A view of this special fire-alarm equipment is shown in Fig. 10. Mounted on a panel are special tell-tale and other relays and back of it are 24 Edison cells for supplying the set with current. This system gives an instant signal to the engineer, who is always on duty in this room, and he immediately starts the fire pump and sends in an alarm to the city fire department. Holtzer-Cabot apparatus was used in this installation.

Throughout the building there are a large number of telephones which terminate in a private branch exchange on the main floor. This exchange is connected through an underground duct line with the nearest pole lines of the Chicago Telephone Company.

An ingenious special signaling system has been installed in connection with the ballroom. The idea of it is to enable the leader of the orchestra to flash a signal in various portions of the large building when a new dance number is to be begun. The operating station of this system is in the form of a compact dial placed for the purpose of photographing on the railing of the stage of the ballroom, as shown in Fig. 15. This is connected by two cables with floor receptacles directly back of the footlights. One of these cables controls a special lighting circuit and the other controls the indicating circuit of the various indicators installed. One of these is shown near the center of Fig. 1 directly to the right of the large urn. Each of these stations consists of a dial about 18 inches in diameter, in the upper portion of which is a small window. Some of these dials, such as the one shown in Fig. 1, are double-faced. Within the dial is a relay which operates to advance step by step a light wheel framework near the circumference of which are numbers running up to 20. When the button at the top of the sending station shown in Fig. 15 is depressed, each of the dials is advanced one position and at the same time is illuminated, thus attracting the attention of persons in that portion of the building. This apparatus was furnished by Walker Brothers & Haviland.

All of the wiring throughout the building is in conduit, even the wires for the various low-voltage signaling systems described and for the elevator annunciators, etc.

The architects of the building were Marshall & Fox, Chicago, Ill. The entire electrical equipment, with the exception of telephones, electric elevators and the installation in the transformer room, was installed by the White City Electric Company, Chicago, Ill. The electrical and mechanical equipment in the building is in direct charge of A. M. Petersen, who is superintendent of buildings and grounds for the club.

Motors on Interurban Service Lines.

With the rapid extension of interurban railways through rural communities there are resulting an increased number of isolated motor drives operating upon the 550-volt direct current obtained from trolley feeders. This service is particularly severe in some respects. High-voltage motors are prone to give trouble from sparking and, due to the grounded circuits, there is an additional strain upon the insulation. Added to these difficulties is that of fluctuating voltage, a variation of 100 volts from normal being not infrequent.

Ordinary shunt-wound motors placed on this service are likely to prove unsatisfactory. The use of interpoles on 550-volt motors is now common and is particularly recommended for this service. This will tend to improve commutation.

Due to the fluctuations in voltage the speed of motors in this service usually varies materially. To overcome this trouble the use of compound wound motors is recommended. When the voltage increases and brings up the speed, an increase of load will generally result. This increased load strengthens the series field and reduces the speed, hence a more uniform rotation results. The effect of this strengthened field is also beneficial to commutation. It is difficult to anticipate the amount of compounding that will be most effective. A standard 20 per cent compound motor usually has sufficient series winding. By shunting the series winding with German silver a ratio can be obtained by trial which will give excellent results.

Gordon Fox.

M. A. Shadley has opened headquarters for electrical construction and repair work, under the firm name of Shadley Electric Company, 704 Wyandotte Street, Kansas City, Mo. Mr. Shadley was with the Squire Electric & Construction Company for a number of years.

A JOB-COST SYSTEM FOR CONTRACTORS.

By A. R. Schmidt.

As supplementing the article by George W. Hill, published in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for March 18, 1916, describing a "Direct-Method Job-Cost System" for electrical contractors, it may be of interest to describe the system in use by the A. R. Schmidt Electric Company, of Milwaukee, Wis.

About 1901, when this company started in the contracting, manufacturing and repair business a job-cost system was inaugurated which is very similar to the one shown in the issue of March 18 and we are using it today, and would not do without it, as it shows, at a glance, how much we lost and gained on each particular job, and further, in disputes of bills it is a perfect record. We not only can trace when material was delivered, by whom it was received, but the party can be brought up as a witness, if necessary.

As stated above our job-cost system sheet is similar to the one shown, but somewhat larger in size. We have been trying to eliminate certain columns in order to make the sheet smaller, but we have been unable to find a way whereby we could combine these columns, as all seem so essential as they appear at present.

With reference to Mr. Hill's job-cost sheet there is shown in the first column (No. 29) estimated quantities of material. This column is not included on our record sheet, but in order to have a record of how the actual material used compares with the estimate, a duplicate sheet of the original estimate is fastened to the job-cost record.

The second column of Mr. Hill's sheet is the same as that used by the Schmidt company, both specifying the kind of material issued. The third and fourth columns of Mr. Hill's sheet, termed Nos. 31 and 32, are the same as on the sheet of the A. R. Schmidt Electric Company, with the exception that in the latter the dates when material is taken out of the store and when returned are given.

We show the cost of material, cost of labor and total cost, each in a separate column and have the sheet large enough to make out an itemized bill.

There was a time when our company thought that this cost system took up too much time, but when consulting with expert accountants we were advised that this was the soul of our business and that they could not improve on it.

The accompanying illustration shows one of the job-cost sheets now in use. It differs with the one adopted in 1901 only in that the latter was subdivided with horizontal red lines for smaller jobs. Omitting the red lines is considered an improvement, as we now will not put more than one job on a sheet, no matter how small. The reason for this is that when a bill is paid these sheets are stamped showing the date when paid and check number and then filed away. If one or more jobs were put on the same sheet, say for instance three, and one was not paid this sheet would have to be kept on file and would become cumbersome. If only one job is put on a sheet and is paid then the sheet is filed away in alphabetical order with all the necessary repair orders, workman time slips, store-room orders, city inspection fees and permits, Underwriters' correspondence, if any, etc. In fact, anything pertaining to this work is filed with this sheet, so if desired for reference the whole job can be looked up at a moment's notice.

REPAIR ORDER

A. R. SCHMIDT ELECTRIC CO.

COR. E. WATER AND BUFFALO

Name_____

Address_____

Order Received_____ 19_____ M_____

Material used_____

Remarks_____

Repaired by_____ Hours_____ Min._____

Repairs Satisfactorily Completed_____ 19_____

VOID IF NOT SIGNED BY CUSTOMER

TIME AND MATERIAL USED MUST BOTH BE SIGNED FOR

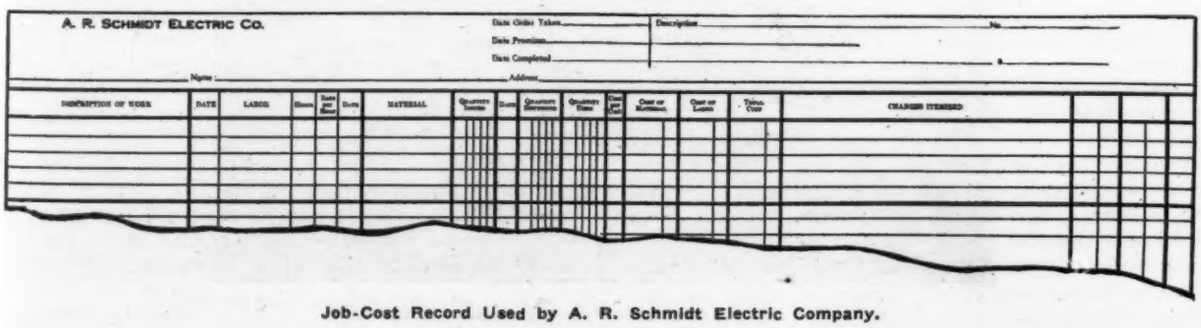
Repair Order Showing Material and Time.

With reference to workman time slips, also shown, they are signed every night and must be O. K.'d every week before the workmen receive their pay. This is the way we have been running our business since 1901.

It may appear to some of the more modern contractors old fashioned, but we have found it serves our purpose and we are glad after 16 years' experience that other contractors have thought so.

Opposes Use of Emergency Switches.

In a recent message to the City Council of Portland, Ore., City Electrical Inspector Dunlop recommended that the section of the building code requiring emergency electric light and power switches in buildings be amended to do away with this requirement. Mr. Dunlop stated this practice is not only very expensive but unnecessary. The law requires a switch placed in halls, so that the power can be turned off quickly in case of fire or accident.



Job-Cost Record Used by A. R. Schmidt Electric Company.

THE DEALER AND STOREKEEPER

An Exchange of Ideas and Experiences on Advertising and Selling Methods, and Store-Keeping for the Dealer in Electrical Goods

How the Dealer Can Tie In on "Wire-Your-Home" Campaign.

The merchandiser, as a general rule, is not in a position to conduct an individual house-wiring campaign to parallel the nation-wide "Wire-Your-Home-Month" campaign instituted by the Society for Electrical Development for the period from March 15 to April 15, but he is in a position to profit by the sale of appliances, because the list of prospective users is sure to be greater as a result of this campaign. If the dealer takes wiring contracts he may be in a position to also secure some profitable business as a direct result of the campaign.

Since the movement cannot be of anything else but benefit to the dealer, a few pertinent suggestions regarding ways in which he may aid will not be out of place at this time.

First, realizing his chances for profit, the merchandiser surely is in a position to lend his moral support to the movement. The dealer who can capitalize on the movement cannot afford to sit calmly by and wait for returns which are the result of the work of his co-workers in the electrical industry, the central-station interests and manufacturers. The latter cannot be expected to assume all the burdens even though they share in the profits. If the central station adds a customer as a result of the campaign it is well and good, for it reaps in the form of additional load. But manufacturers and dealers will profit indirectly, and by reason of this they should lend their moral and actual support. The manufacturers are co-operating with the Society in the movement, and many of them are doing more than their full share toward its support. The merchandiser, as a form of moral support, should become imbued with the idea of doing all he can think of to aid the movement, and then find some aids he did not think of.

Besides "boosting" the house-wiring campaign to the best of his ability the merchandiser is in a position to lend material aid in two ways. The first is by means of his window displays. He may install the standard window display distributed by the Society for Electrical Development, and he may alternate that display with some of his own design. If he did not receive the standard display, certainly some mention of the campaign should be made in his windows. This may be done by window displays showing special-sale articles offered as special inducements to those installing wiring in old houses, but the special sales or any other announcements should unquestionably be linked to the house-wiring movement.

As an instance of this kind of display the accompanying illustration shows a window which is very opportune during the house-wiring campaign. This window was maintained by the Philadelphia Electric Company during Electrical Prosperity Week. It shows a miniature dwelling, about four feet long by two feet wide and five feet high. No attempt was made to make it a specimen of architecture, but efforts were made to have it a replica of the problems met with by an electrician in the wiring of old houses and the means used to solve these problems without damage to the house. The miniature house showed six rooms and a bath, each room furnished completely and with electrical service. No attempt was made to minimize the facts of the case. Where it was necessary to take up a board or open a wall for wiring this was done. Explanations were made to show the new way in which electricians try to do their work in old houses, by making an installation with the least dirt and muss possible. The window was notable for the decided effort made to clearly portray the advantages of electricity so that the favorable impression created was one that was made to last. The window display described elicited over 900 inquiries during one week.

If it is not possible for dealer to make as elaborate a display as that of the Philadelphia Company, he may simulate the idea in a window display of less pretentious design. Two miniature houses may be shown, one lighted with a modern tungsten lamp and the other with a dim light, serving to show a comparison of houses lighted with electricity and less-modern methods. Cards may state that the spectators whose homes are not lighted with electricity should compare their own lighting with that of an electrically lighted home.

Attractive Window Display of Philadelphia Electric Company.

The average man knows very little about electricity; especially those who do not have service in their own homes. The dealer may educate those who do not have electric service, as well as increase his own business, by showing a

few specimens of switches, panelboards, outlets, lamps, fuse boxes, batteries, etc., explaining their uses. Such displays are bound to create interest and eventually create business.

There is another opportunity for the merchandiser to aid the house-wiring campaign. This is by the insertion of advertisements in local papers.

The purpose of the Society for Electrical Development is first to get the industry interested in the movement and then to back it in its endeavor along its lines. It is impossible for the Society to reach the individual public thoroughly. This must be left to those of the electrical industry in the numerous communities. This is the reason why advertisements in local newspapers will do much to appraise the public of the fact that there is a house-wiring campaign and that the public has an opportunity to benefit by reason of the endeavor of the electrical industry to increase the use of electricity and educate people to the benefits to be derived therefrom.

The merchandiser should hitch his advertisements to "Wire-Your-Home Month." The manufacturers have been very far-seeing in their efforts to further the movement to aid the efforts of the Society for Electrical Development. Vast amounts of literature containing wide experience and selling ideas have been prepared and distributed by the manufacturers, and have been placed at the dealers' disposal. Excellent and appropriate electrotype cuts of advertisements may be secured from a number of the most prominent manufacturers, and these cuts can be used to the very best advantage by merchandisers in any city in the country. It is only necessary for the merchandiser to express his interest in the campaign and he will be assisted in every manner possible.

The merchandiser can possibly do more legitimate "boosting" by means of local advertisements than in any other way. The returns to him will be reflected back by his efforts and the effect they will have on his co-operation with other factors in the movement.

Results Obtained from Window Displays.

A considerable share of the prosperity of the Midland Electric Company, of Mason City, Iowa, is justly attributed to the attention given the matter of window dressing and general appearance of the store of this organization. Manager Zahm is a firm believer in the advertising value of an attractive window and every effort is made to instil timeliness and dignity into the display.

Through the courtesy of the *Northwestern Buzzer,* published by the Northwestern Electrical Equipment Company, St. Paul, Minn., we are enabled to show a particularly attractive display of the Midland company which has attracted considerable attention. Eveready goods are shown exclusively. This idea of displaying one company's line is followed quite frequently by the company.

Window of Midland Electric Company.

A FEW POINTERS FOR BUILDING UP AN ELECTRICAL SUPPLY BUSINESS.

Details of an Interesting Sale of an Electric Washing Machine—Other Notes for the Merchandiser.

By J. S. Vogel.

If you, Mr. Electrical Dealer, could turn every inquiry into an order your business would soon double itself. Is there any reason why you should not be able to turn inquiries into orders? When a person enters your store to look at a certain article have you any methods by which you can make a customer of this person?

Suppose a lady came to your store and asked to look at an electric washer, just how would you handle a prospective customer of this kind? If you are an average dealer the chances are you would simply show her the washer, explain how it works, and let it go at that. But this method is erroneous, because it does not produce the maximum number of sales—and you are in business for the purpose of making all the sales you can. Your profit depends upon the number of sales you make, and not upon the number of people who come to your store to look at merchandise, and then leave without buying.

A Chicago housewife recently bought an electric washing machine, and the story of how she bought it should be interesting to electrical dealers, because it points out why the average dealer does not make more sales of this class of merchandise.

The lady went from one electrical shop to another, simply to investigate the claims made for the various makes of washers. All told, she visited six dealers. The first five dealers she called on were courteous in every respect. They showed her the washer, and explained how it worked. But when the lady explained that she wished to examine the different makes before buying the salesman lost interest, and made no special effort to make a sale. Not one of the first five dealers asked for her name and address.

At the sixth place the man who showed her the machine was a real salesman. He explained the washer to her, its operation, desirable features and many advantages over old style washers. At the conclusion of this explanation, the salesman asked for her name and address, saying that he wished to send her a catalog. This was agreeable, and the lady left the store feeling that the salesman had made a special effort to please her.

The salesman did not forget about the prospective buyer the moment she left the store. In fact, he realized his work had only started. The promised catalog was delivered by a messenger on the same day, this method of delivery being more impressive than if it had been delivered by mail. Two days later the salesman called in person. He called during the evening, because he also wanted to meet the husband, knowing that when an article costing something like a hundred dollars was to be purchased the consent of husband, as well as wife, would be required before the sale could finally be made.

At the home of the prospective buyer, the salesman's entire argument was one of service. He paid very little attention to explaining what materials the washer was made of, as practically his entire argument was based on what the washer would do. The saving of time and expense, and the convenience of the washer formed his most important arguments. To still further impress these facts upon the minds of the buyers he explained that they had a number of washers in stock, and asked permission to install one of the washers in the home, to be left there for one week's use, without in the least obligating the prospect to buy. This offer was so liberal that it was accepted. The washer proved satisfactory, and the sale was made.

During the interview at the home the salesman found that

the housewife was using a gas iron to do her ironing. On the day the washer was used in its demonstration trial, the salesman sent a boy with an electric iron to the housewife, asking that she use the iron for the one washing, so as to make electricity do as much of the week's work as possible. The electric iron remained with the washer.

One of the most important things in selling electrical specialties is to get them into the home. The housewife who has been doing her washing with the old-style washer does not realize the great advantages of an electric machine over all others. She has never used one, and has no correct way of judging its real value.

It is the same with other electrical specialties. Housewives do not know to what extent electricity can be made to shorten their hours of work, and to do it better than would otherwise be possible. The housewife knows the value of electric light, because she has used it, but she does not know the enjoyment she would get from a good table or reading lamp, because she has never used one, and for that reason cannot properly make comparisons.

It is safe to say that there is not a home in which electricity is used but what some electric specialty could be sold if the housewife knew its real value or convenience. The dealer should make a specialty of finding out just what electrical supplies could best be used by his customers, and then do his level best to place these specialties in every home where electricity is used.

How many homes are there with an electric toaster, a percolator, or even a table lamp? Very few, when compared to the enormous number of homes where electricity is used. Electric irons are popular, because the housewife has been educated to their use by extensive advertising. Nearly every home that has an electric iron should have an electric washing machine. To bring this about will require hard work and hustling by electrical dealers. But in the present day of keen competition, the dealer who does the most hustling is sure to make the most sales.

People are interested in electrical appliances. This is proved by the number of prospective buyers who daily enter electrical stores—even if they do not buy. It is up to the dealer to turn inquiries into sales. The mere fact that people take the trouble to come to your store to look at various articles is proof in itself that they are interested, and that a sale can be made, if the dealer only takes the trouble of going after this business—and going after it hard.

Your advertising alone will not make sales. Advertising brings people to your store, but that is as much as you can expect it to do. After a prospective buyer is in your store it is up to you to make the sale. If you cannot make it while the customer is in your store do not take it for granted that he is not interested. Get his name and address, and then keep after him until the sale has been made.

If you advertise to get people to come to your store then you are paying out real money for the privilege of showing your goods to these people. Whether your advertising pays, or does not pay, depends entirely upon the amount of sales you make. If you can make customers of those who are only casually interested your business will soon increase, and your work will be well paid for in the way of added profits derived from such sales.

Electricity is one of the liveliest things in existence. To live up to its reputation one must be a live wire. The dealer should do the things he thinks any live-wire dealer would do. He should not remain in the store all the time, expecting people to come there. It is necessary to go out after customers once in a while. The sale that's worth while is usually worth going after.

Lamp Window Display.

The pleasing effects that can be obtained in window dressing by utilizing the equipment furnished by the manufacturers is shown in the accompanying view of an electrical dealer's window in Iowa. It is interesting to note that many direct sales were traced to this display, although the population of the town is less than 800.

Lamp Window Display in Town of 800 Inhabitants.

One Dealer Selling 624 Irons Per Month in Louisville.

An example of what can be done in training salesmen is shown in the report of a Louisville electric appliance dealer who started an electric flat-iron campaign February 1, using untrained solicitors in a house-to-house canvass. More than 200 replies were received in response to an advertisement for canvassers—out of which number 10 were selected to carry on the work. During the first two weeks of the effort, which was devoted to placing the irons on trial, practically no irons were sold, and the advisability of dropping the plan was considered. Robert Montgomery, commercial manager of the Louisville Gas & Electric Company, was appealed to, however, and he immediately sensed the trouble. He found that the salesmen, although experienced in other lines, knew very little of the psychology of salesmanship. He devoted some time to training and instructing them in the proper approach of a prospect with the result that sales immediately began to increase wonderfully and are now at the rate of 624 per month. Since the start of the campaign February 1, a total of 876 flat irons have been sold by the one dealer and the campaign is being persistently prosecuted with greatly increased vigor.

Window-Display Contest for House-Wiring Week.

Prizes of $25, $15 and $10 will be given during the week of April 3, by the Cincinnati Electrical Show Company for the best window displays featuring electricity. This was decided upon last week at a meeting of members of the company which handled the great electrical display in connection with the celebration of Electrical Prosperity Week last fall. A week of educational newspaper advertising will also be conducted, devoted especially to the use of electricity for domestic purposes.

National Association of Electrical Inspectors.

HUBERT S. WYNKOOP, President, 1574 Fiftieth Street, Brooklyn, N. Y.
WASHINGTON DEVEREUX, Vice-President, 131 South Fourth Street, Philadelphia, Pa.
WILLIAM LINCOLN SMITH, Secretary and Treasurer, Concord, Mass.
R. P. STRONG, Representative on Electrical Committee of National Fire Protection Association, 809 Hibernian Bank Building, New Orleans, La.

Executive Committee
J. C. FORSYTH, Chairman, 123 William Street, New York City.

SECTION REPRESENTATIVES:
C. H. Fletcher, J. C. Digby, British Columbia.
A. W. Hopkins, G. W. Perry, Western New England.
Washington Devereux, A. H. Lilley, Philadelphia.
E. N. Davis, H. A. Knight, Eastern Massachusetts.
M. L. Pomares, O. E. Smith, New York City.
Arthur Kempston, G. A. Cleary, California.

MEMBERS AT LARGE:
K. W. Adkins, St. Louis, Mo.
Emil Anderson, Minneapolis, Minn.
F. G. Hartwell, Boston, Mass.
J. E. Latta, Chicago, Ill.
James B. McCarthy, Detroit, Mich.
H. G. Veit, Cleveland, O.

"LET THE CODE DECIDE."

Secretary's Message.

The secretary recently received a letter from W. A. Oswald, the secretary of the British Columbia Section. After hoping that I had not concluded the Section was defunct, he went on to say that they had been pretty hard hit. A year ago the Section had on my list 18 members and Brother Oswald states that they have six members now in the military service of the Empire; that is 33 per cent. Further, that several of the departments have had to work with reduced staffs.

He then goes on to say that on March 10 they held their annual meeting and enthusiastically resolved to keep the light burning and try during the coming year to enlarge the membership and scope.

The following officers were elected: President, C. H. Fletcher, city electrician, Vancouver (re-elected); vice-president, T. C. Duncan, city electrical superintendent, Prince Rupert, B. C.; secretary-treasurer, W. A. Oswald, Vancouver (re-elected); J. C. Digby, chief electrical inspector of New Westminster, was elected to represent the Section on the Executive Committee of the National Association, in place of Mr. Hubbard, retired.

I feel sure that under the circumstances no one could criticize our brothers of British Columbia for inactivity. We all realize and sympathize with them in the difficulties under which they labor and I am sure that we all should like to be near enough to encourage the members of Section No. 1 personally.

I wish to remind the section secretaries that the annual fees are now due, and the members at large that their dues for 1916 are due April 1.

I intend to write the section secretaries shortly, and should have before this had it not been for a rather severe trouble with my eyes which is only just beginning to clear away.

As to the two questions published herewith, it may be noted that Question 320 came from New England, and Question 321 from west of the Mississippi. Question 321 was received last November and Question 320 in January.

I was just going to print Question 321 when Question 320 came in, and as the latter part of this was closely related in subject matter I decided to wait and print the two together.

I desire particularly to call the members' attention to Answer 11 to Question 320. It was the result of considerable thought and study on the writer's part, who at my suggestion amplified his original reply and looked into the matter quite carefully.

The matter appearing in this section consists of questions on the National Electrical Code, its interpretation and meaning, and questions as to whether certain methods of wiring are in accord therewith. These questions are gladly received from anyone interested, even if not a member; they should be sent to the secretary with any needed elucidating sketch. They are answered by each member of the Executive Committee according to his knowledge of what the ruling would be in his jurisdiction.

It should be understood that no pretense is made to give an authoritative interpretation of the Code. This is a voluntary association; it has representation on the Electrical Committee of the National Fire Protection Association, which prepares the Code, but it has no right, and claims no right, to give a final interpretation of anything in the Code. It is only intended to give the interpretation which seems correct to the members of the Executive Committee. No attempt is made to edit or correlate the answers from the different members of the Committee, as it is felt that the occasional difference of opinion is calculated to lead to a further study of the matter in question, further discussion and the final clearing up of obscure points.

The aim is to help toward a better understanding of the Code on the part of all; a more uniform conception of its meaning; increased precision in applying it; and harmonious action of those using it, for the common good.

Rules on Grounding.

Question 320. Please interpret the exact meaning of Rule 12*f*, third paragraph, on page 24 of 1915 Code, under various combinations of possible ground sizes.

Also, what size of ground wire should be used for grounding an 800,000-circular-mil cable to a 1.5-inch galvanized-iron water pipe?

Answer 1(P)*. The rule says nothing about grounding sizes. The service conduit must be effectively insulated or grounded; if the latter it must have its own ground wire installed as prescribed. Rule 15*d* gives the sizes of ground wires under different conditions.

(Secretary's note: It is obvious that the writer has failed to notice that the gentleman who sent in this question really embodied in one question two distinct matters. It will be noticed that several others have made the same slip.)

Answer (2S)*. Rule 12*f*, sixth paragraph states that the conduit ground must be at least No. 6 wire. The third paragraph of this rule states that this ground wire is to be independent of and in addition to any other ground wire on metal conduit, etc. Conduit systems, other than the service conduit, should be grounded as required by the rules for such systems. See Rules 27*c*, 28*f* and 29*d*.

If the secondary is not to be grounded, the above will ground the conduit systems as required by the Code. If there is a secondary ground required and same is installed according to Rule 15, the service-conduit ground wire may be connected to the secondary ground wire and one ground wire is all that is required for both. Do not overlook the fine-print note under Rule 12*f*, which states that the ground on the conduit system is not to be considered as a ground for the secondary system.

Answer 3(B)*. The portion of Rule 12*f* referred to in this question plainly states that ground wire must be of copper, at least No. 6 B.&S. gauge (where largest wire in conduit is not larger than No. 0 B.&S.) and need not

be larger than No. 4 B.&S. where the largest wire in the conduit is larger than No. 0. It would therefore appear plain that a No. 4 wire under the rule would be satisfactory for the grounding of a service pipe within which was an 800,000-circular-mil cable.

Answer 4(F and G). Our interpretation of Rule 12*f* is that the service conduit, i. e., "that portion of conduit between the outside source of supply and the first cutout inside the building," should not be in metallic contact with any other metal work or piping in or on the building, or if in contact therewith should have a *separate, independent* ground to water or gas piping or other suitable ground.

A ground wire attached to metal piping need not be of greater capacity than that of the pipe to which it is attached. If the piping is not of sufficient size to protect the installation properly, then other suitable grounds should be provided. The 1.5-inch galvanized pipe mentioned would have a carrying capacity about equal to that of a No. 0000 B.&S. gauge wire of copper. This latter would require about 4,500 amperes to fuse it, therefore it would appear to be of ample size to protect an 800,000-circular-mil cable properly.

Answer 5(B)*. Where a larger ground wire than can be suitably handled by an approved ground clamp is used, the matter should be left to the inspector's discretion. If the water pipe is the only available ground, the correct procedure would be to use a ground wire equivalent to the safe carrying capacity of the pipe. This might be estimated approximately in this case as a 350,000-circular-mil ground wire.

Answer 6(D). Part 1. Use No. 6 B.&S. Part 2. Use No. 4 B.&S.

Answer 7(H)*. Use No. 6 B.&S., if wire in pipe is No. 0 or smaller. Use No. 4 B.&S., if pipe contains anything larger than No. 0. I should find a larger ground. I do not believe ordinary galvanized 1.5-inch water pipe would carry sufficient proportion of current for which 800,000-circular-mil copper would be used.

Answer 8(O). The only portion of Rule 12*f* which might need interpretation seems to be the sixth paragraph, referring to sizes of ground wire. The intent of this paragraph, as I understand it, is so to fix the size of the ground wire that it may not be smaller in any case than No. 6. B.&S., and will be a No. 4 or larger in case the largest wire in the conduit is greater than No. 0. However, the expression used "need not be greater than No. 4" does not prohibit a No. 6, although I think said prohibition was intended where there is a service wire in the conduit larger than No. 0.

In answer to the second part of the question, if the cable is part of an alternating-current system, the ground wire should not be less than No. 6, which applies also if the cable is the neutral of a direct-current system and the ground is not at a central station. If it is a direct-current neutral at a central station, the ground wire must, according to Rule 15*d*, be 800,000 circular mils.

Answer 9(T). By referring to Rule 12*f*, sixth paragraph, one will find the required ground-wire sizes; according to this the ground-wire size would be No. 4 B.&S. gauge.

Answer 10(N)*. The first part of this question is really comparatively simple. We may have:

A. Service conduit entering building underground through basement wall, ending in an iron box containing service fuse and switch; thence conduit running to an iron cabinet containing meter, and from this sub-mains in conduit running to several distribution centers.

B. Service conduit entering service cutout box as above, but the wires then running exposed to meter board and then entering the building conduit running to the distribution centers.

C. Service conduit running up to the meter, meter exposed, conduit beginning again on house side of meter.

D. All wiring in building beyond the service cutout, knob and tube or exposed, etc.

A^1, B^1, C^1, D^1, which are duplicates of the first four, except that the service conduit begins somewhere near the eaves, comes down the face of the building and enters near the sill.

Case A and A^1: service conduit must be grounded.

Case B and B^1: service conduit *need* not be grounded.

Case C and C^1: service conduit must be grounded because it extends beyond the service cutout box and this latter portion is building conduit.

Case D and D^1: service conduit need *not* be grounded.

It should be noted that Rule 12*f*, third paragraph, makes no exception as to whether the service conduit enters *via* a trench or from overhead. This I presume is because dry earth about the pipe could not be trusted as a ground in such a case, as running through ordinary fill alongside a house, a made lawn, across sidewalk and up the pole on the street side of walk.

Suppose now that in Cases B^1 and D^1, both of which do not require grounds normally, the conduit should touch copper piazza roofing, metallic gutter about a bay window, metallic rain conductor at corner; in any of these cases we *must* ground the conduit. The same would be true in case the service conduit touches any metallic work of any kind inside the building. Note also case where open service cutout is looped round by a bridging conduit ground wire.

As to the size of this ground wire it is given in section 6. In the suggested change presented at New York last March in the "Report of Committee on Grounding of Conduit" the wording was "Ground wires must be of copper, at least No. 10 B.&S. gauge, etc." My notes contain the statement that this was changed to "at least No. 6, etc." with the names of several gentlemen who spoke on the matter and a precis of their remarks.

As to the second part of the question; there are two cases where the ground wire would have to be 800,000-circular-mil copper; namely:

A. Where the cable was the neutral of a direct-current system at a station.

B. Where it was one leg of a three-phase system.

In other cases there is implied a considerable leeway, the only specification being a definite *lower* limit of No. 6 B.&S.

The 1.5-inch pipe is almost exactly the equivalent in area of a No. 0000 copper wire.

The specific heat of iron is about 20 per cent higher than that of copper.

By the data in "Herrick's Handbook" it appears that 0.6 ampere will cause 1 millivolt drop in 8 feet of 1.5-inch iron pipe (wrought-iron welded).

No. 0000 copper requires 2.6 amperes to give a similar drop, and is allowed, rubber-covered, 225 amperes.

The 800,000 circular mil is allowed 550 amperes.

The allowed current will give in 8 feet of the copper No. 0000 a drop of 87 millivolts; watts developed, 19.6.

In the iron pipe this same current will give a drop of 275 millivolts and the watts developed will be 84.4; on account of the specific heats however we should take the ratio as 19.6:67.5.

Further, the heat is radiated from a surface in the case

of the wire proportional to 1.78, and in case of the pipe to 6.08.

That is, the heat in the case of the iron to be gotten rid of is 3.44 times that in the case of the copper and the radiating surface is 3.41 times as much. This is practically the same and since the iron will be in cool close-packed earth and most of the time contain water in circulation it is perfectly safe to conclude that it will handle anything which a ground wire up to the capacity of this cable will demand.

We must, of course, consider the potential drop which might run up to 1 volt in 10 feet (550 amperes allowed on 800,000-circular-mil cable) which it is conceivable might sometimes, somewhere, be a cause of difficulty.

The above has been figured on the supposition of direct-current working. If, however, it is an alternating-current circuit, we must consider "skin effect." The thickness of the pipe wall is 0.37 centimeter Cohen states:

"For iron conductors, even for comparatively low frequencies, the current flow is limited to very thin surface layers," and he gives depth of penetration for a frequency of 50 cycles as being 0.07 centimeter, while for copper it is practically 10 times as great, even at 100 cycles. Thus it is obvious that the resistance under alternating-current at 60 cycles would be much increased, for whereas the whole cross-section of the metal pipe wall is 0.80 inch, the effective alternating-current area is but 0.20, one-quarter as great.

Hence, the watts would be increased about from 84 to 336, and the millivolts drop also in the same proportion. Questions of reactance drop have not been considered.

I feel that the whole matter of the carrying capacity of pipes leading into buildings needs inquiring into and very much doubt the premises we are accustomed to go upon; that is, in the case of large services.

Answer 11(E). There are two questions included, the first of which should not be answered, or even considered, without the open book, the National Electrical Code, before us. Should either of my answers appear to be wrong, I do hope someone will rise up in open meeting and, through this Question Box, say so, as I have a large and active territory and a wrong interpretation of a rule, on my part, will react on a number of installing contractors. If you feel that I am wrong, please help the contractors who may suffer.

The first question concerns the use of conduit for the service wires and the various combinations possible and ground-wire sizes.

May I call attention to the wording of the first sentence in the third paragraph of Rule 12*f*? Here we will find that we must either insulate the service conduit from all metal in or on the building, or we must ground the service conduit. Suppose we should have an installation in a frame building. Suppose again, that the service wires from the pole line were attached to insulators secured to the building at the second or third floors and that the service wires, from the insulators, were in conduit and the conduit entered the first floor, then we should find that the service conduit would be insulated from everything and it would not be necessary to ground it. If, however, under the above described conditions, the conduit should enter the frame building in the cellar, I would suggest that the conduit be grounded because of our inability to keep away from ground should the conduit be grasped by a human hand, the person standing on the earth, and the conduit being one side of the system because of a breakdown of the insulation on one of the conductors.

As concerning the application of the suggestions contained in the sixth paragraph of Rule 12*f* some have thought that the requirements of No. 6 B.&S. gauge wire, as a ground wire for the service conduit, is a misprint. A reference to the *Bulletin*, considered at the last open sessions of the Electrical Committee of the National Fire Protection Association, will show two suggestions for a change in this rule, one for the use of No. 10 wire and the other for No. 6 wire. The notes of the writer show that the rule as it now appears in the Code is correct. During the discussion it was brought out that the wires in the conduit were without protection, other than the primary fuses and that No. 10 wire might not be large enough to properly care for the possible inrush of a great current. Should the largest wire in the conduit be larger than No. 0, then we should urge the use of No. 4 B. and S. gauge as a ground wire.

Following this paragraph is a fine-print note which I fear, has confounded some. We should bear in mind that fine-print notes are not rules. (See first paragraph of General Suggestions.) This fine-print note does not say that the ground wire for the service conduit cannot be connected to the ground wire of the secondary system, but it does say, in the form of a suggestion, that the ground on the conduit system is not to be considered as a ground for the secondary system. So, if it be necessary to ground the service conduit, it must be independent of the ground for the conduit, armored-cable or metal-molding system, but may be attached to the ground wire for the secondary system.

The second part of the question, concerning the size of conductor to be used in grounding an 800,000-circular-mil cable, is somewhat indefinite in that it does not state the character of the installation or system. If it was a single-phase or a two-phase system we would suggest that use of No. 6 B. & S. gauge. If, however, it was a three-phase system we would then suggest a wire as great in size as the largest wire in the system. I have been asked a question somewhat similar to this when the water piping, into the building, was not comparable in size and conductivity to the largest wire in the system. My answer to such a condition was to provide a suitable ground should the suggestions found in section *f* and *g*, Rule 15, prove inadequate.

Size of Ground Wire.

Question 221. Rule 15d, second paragraph, is causing me difficulty. I have a 2,500,000-circular-mil cable and the only available pipe is equivalent to about 1,000,000 circular mils; should a 2,500,000-circular-mil ground wire still be required?

Answer 1(U). Use the 2,500,000-circular-mil wire and provide a ground of sufficient size.

Answer 2(R)*. Provided the pipe (equivalent to 1,000,000 circular mils) is the *only* available ground, the additional 1,500,000 circular mils in ground wire is useless.

Answer 3(S)*. Yes. If the pipe is not of proper size, the ground should be reinforced with a ground plate, as called for in Rule 15*g*.

Answer 4(F and G). It would be of no value to use a ground wire in excess of the carrying capacity of the pipe.

Answer 5(A)*. Rule 15*d* reads very clearly and I can see no reason why the size of the wire should be changed.

Answer 6(O). According to the literal construction of Rule 15*d*, second paragraph, the ground wire *must* be of the same size as the circuit wire. In cases where, owing

to the large conductors in use, it is impracticable to install a ground wire of the same size as the conductors, I should judge the same result should be obtained by installing a number of ground wires connected to different grounds, the aggregate current carrying capacity of the ground wires being equivalent to that of the conductor.

Answer 7(T). Yes, if full compliance with the intent of this rule is contemplated.

Answer 8(M). If the size of the circuit wire is 2,500,000 circular mils, the size of the ground wire must be the equivalent in size of the same (or within a reasonably narrow margin).

Answer 9(N)*. The rule and section quoted allow no alternative, hence the ground wire must be 2,500,000 circular mils. This will throw the whole burden upon the pipe.

I judge the circuit would be allowed about 1,500 amperes. It might be 25 cycles or 60 cycles; nothing is said and the question is indefinite to this extent. If the pipe is the equivalent of about 1,000,000-circular-mil copper (allowed say 1,000 amperes) the pipe might take somewhere from one-fourth to one-half as much. If the pipe lacked water flow I think the allowed line current might destroy it, not possibly if close-packed with damp earth, but if the trench fill had settled away from it somewhere.

I feel that the pipe should be reinforced with several well separated, carefully made grounds.

The whole matter of secondary grounds on water pipes in the case of large-capacity circuits, especially polyphase power circuits as this presumably is, is I feel a matter about which there is little or no reliable information, and which might well repay careful research, as would also the whole subject of conductivity of conduit installations in buildings. I suspect we are really pretty much in the dark and taking some things altogether too much for granted.

Testing Underground Cables with Direct Current.

During the second week in February the Institution of Electrical Engineers, both at the London (England) meeting, and at three of the provincial sections, considered a paper by O. L. Record, on the testing of underground cables with direct current. He explained the object of testing cables after laying, submitting them to a high-tension test, not to verify the dielectric qualities of the insulation, such qualities having been amply proved by the test at the factory during manufacture, but to insure that the cable and the boxes, when laid, are in good condition. This high-tension test becomes of so much the more, and a low-tension test of so much the less value, as the working voltage at which the cable will operate is raised.

As a rule, after having been laid, the cable is tested at double the working voltage. Up to the present, for the want of static apparatus of sufficient power for this test, transformers have been used, or occasionally alternators connected direct to the cable. This, said Mr. Record, is easy, when it is merely a question of testing a short network having a length of one to two miles, for example, to work at a pressure of, say 5,000 volts or less, when the corresponding test pressure will not exceed 10,000 volts. The charging current at a frequency of 50 cycles only reaches two or three amperes, and a transformer rated at about 20 kilowatts will be sufficient.

The question becomes complicated when it is a matter of testing, for example, at 40,000 volts, a network extending to something like 12 miles. The charging current might then reach as much as 27 amperes, corresponding to a power of 1,000 kilovolt-amperes. The dimensions of such a transformer can be imagined.

Mr. Record reviewed the difficulties in testing with alternating current, after laying, and the advantages of the direct-current test. By means of the latter electric supply authorities can as often as desired repeat their tests without raising the opposition of the cable manufacturers, and they can test at one and the same time, if not their whole network, the total insulation of which might be too low, at least all the feeders. In virtue of the maxim, "Necessity is the mother of invention," there have been produced in the course of the last few years various types of apparatus of a practical nature for carrying out such direct-current tests. One type of apparatus—the Delon revolving contact maker—of the Société Française des Cables Electriques, was described in some detail, and a brief account was given of the Abraham-Villard electrostatic voltmeter for measuring directly the difference of potential.

The Electric Locomotive.

F. W. Carter read a paper before the London Institution of Civil Engineers on January 11, entitled "The Electric Locomotive. Mr. Carter said that the electric locomotive for use on main-line railroads had already reached a high state of development in countries where conditions were favorable to electrical operation. The number of distinct types that had been developed was large and it was somewhat difficult to classify them simply and satisfactorily. Development had taken place along two lines, one based on tramway experience and the other on steam locomotive practice. Electric locomotives suitably controlled were capable of making very efficient use of their adhesive weight for developing drawbar pull and on this account electrical operation often showed to advantage where gradients were long and steep. Where such conditions prevailed the question of the return of energy to the source by using the motors regeneratively became of interest.

Electric locomotives admit of a primary division into two groups, those in which the axles are driven independently and those in which they are coupled and driven collectively. With a few exceptions these two groups correspond with the continuous-current and the alternating-current systems of operation respectively. With the exception of the Pennsylvania Railroad locomotives, all important side-rod locomotives had been designed for alternating-current systems. With the exception of the Norfolk & Western locomotives, all driving through jack shafts had been designed to use single-phase commutator motors; with the exception of the later Lötschberg locomotives, all driving through Scotch yokes employed polyphase motors.

Two methods were used for driving the axles independently, the geared and the gearless; unless the driving was arranged to be effected through a spring-supported quill both methods added to the dead weight carried by the axle; the amount of the additional weight was of interest from its bearing on the maintenance of the parts. Collective driving through side rods assumed several forms, but all resulted in considerable strains in the structure. Where the locomotive was driven by motors of uniform torque the main driving forces caused alternating stresses of low frequency in the structure, but where the driving torque was impulsive the resultant frequency became comparable with the natural frequencies of vibration of some of the parts and at certain speeds destructive vibrations were liable to be set up from resonance between the frequency of the main driving torque and the natural frequency of vibration of some part or parts.

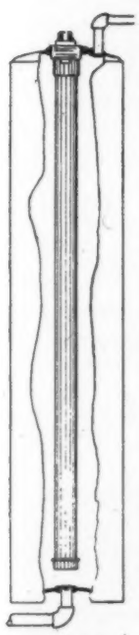
NEW APPLIANCES

A Weekly Review of the Latest Developments and Current Information Respecting Electrical and Kindred Mechanical Appliances

Lee Electric Water-Heater.

The unity load-factor so keenly sought by central stations is one of the primary features achieved in the design of the Lee electric water-heater recently placed on the market. The undesirable load feature and operating cost of the instantaneous water-heater has been entirely overcome by the advent of this continuous-use domestic appliance.

The most popular sizes in use are the single-heat elements of 500 and 750 watts, although the line is completed with 1,500 and 2,000-watt sizes with three-heat control.



Electric Water-Heater

Inasmuch as these are insert water-heaters and are practically of 100 per cent efficiency, the most desirable results are obtained. All the energy supplied to the unit is dissipated in the water in the form of heat without loss. A number of tests made by various laboratories show that water can be had at various hours, ranging in temperature from 110 to 185 degrees Fahrenheit, or approximately 45 gallons every 24 hours at a temperature of 115 degrees (bath temperature), which is more than enough for the average household.

In construction the water-heater is like a pipe or rod 1.25 inches in diameter, 56.5 inches long, and threaded for one inch at the top, so that it is only necessary to insert this unit through the standard opening in the top of any ordinary range tank. This rod is filled with an insulating, non-oxidizing fluid in which is submerged the open resistance coil or heating element, a construction similar to that of Lee electric radiators, which were described in these columns not long ago.

The Lee Electric Radiator Company, Peoples Gas Building, Chicago, Ill., furnishes this device complete with a special heat-resisting cover for the tank. This retains and conserves the heat, so that every heat unit supplied by the electric current continuously is stored in the water and made available when necessary.

Another 15,000-Horsepower Motor for a Reversing Rolling Mill.

The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has sold to the National Tube Company the electrical equipment to drive a new 40-inch reversing rolling mill which it is about to install in its plant at Lorain, O.

This rolling mill, when completed, will be one of the largest in the country. The reversing motor will develop 15,000 horsepower and will run at a maximum speed of about 120 revolutions per minute. The power for this reversing motor will be supplied by a flywheel-motor-generator set which will be so controlled that the load on the power plant will be limited to approximately 3,000 kilowatts.

One of the novel features of this equipment is the arrangement made to allow the reversing motor to be turned over slowly for setting up the mill without running the flywheel-motor-generator set.

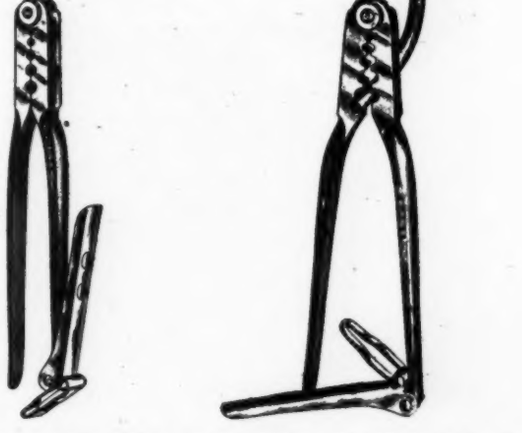
A sale of a similar equipment has been made to the Indiana Steel Company, which has purchased Westinghouse electrical equipment to drive and control a new 40-inch reversing blooming mill that is to be installed in its plant at Gary, Ind. The capacity of the reversing motor will be 15,000 horsepower and it will be supplied with power by a flywheel-motor-generator set.

In addition to these two units the Westinghouse company is at present building the electrical equipment for four other reversing mills, two of which are approximately the same size as those mentioned above. One of these was briefly described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of January 22, 1916.

The Leverlink, an Attachment for Splicing Clamps.

A unique attachment for splicing clamps, known as the "Leverlink" is being marketed by Mathias Klein & Sons, Chicago, Ill. It is in the nature of a very desirable improvement which will undoubtedly prove a welcome addition to the "Connector" family. Its function is to clamp the handles, once the jaws are in place over the wire, which is thus held securely during the operation of splicing. The "Leverlink" has a universal adaptation, being made for attachment to any standard size of clamp. It is riveted to one handle of the clamp in such a manner as to allow the link to slip over the other handle. (See Fig. 1.) Pressing down on the lever locks the link in place and holds the handles of the clamp securely together, causing the jaws to grip the sleeve or wire like a vise.

Another method of using the "Leverlink" is illustrated



Figs. 1 and 2.—Two Methods of Using the Leverlink Attachment for Splicing Clamps.

in Fig. 2. The lever may be thrown around to the position usually occupied by the link. It is provided with a series of holes, and after the wire has been gripped, the lower handle is slipped through one of these holes, thus locking the grip and holding the wire securely, as before.

Universal Generating Set for Isolated Service.

For use in places remote from the lines of electric power companies, small self-contained generating sets are frequently required. A set of this type, upon the perfection of which a great deal of time and effort have been spent, is that made by the Universal Motor Company, Oshkosh, Wis. This company has been in the business of manufacturing internal-combustion engines and generating plants

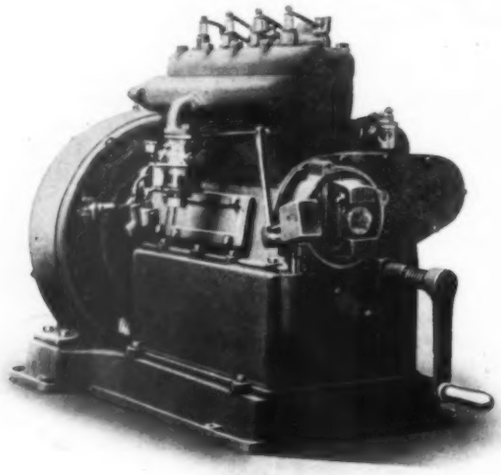


Fig. 1.—Universal Four-Kilowatt Generating Set.

for some 20 years, and the plant illustrated and described herewith is the result of long and fruitful experience. The engine is of the gasoline type and is direct-connected to the generator, the rating of the set being four kilowatts. The design of the engine is very compact and incorporates many features especially developed for use in a set of this type. The engine is a four-cylinder machine, thus giving a very uniform torque, which is evident from the fact that no flywheel is necessary, the armature of the generator being the only rotating mass. The set is very steady in

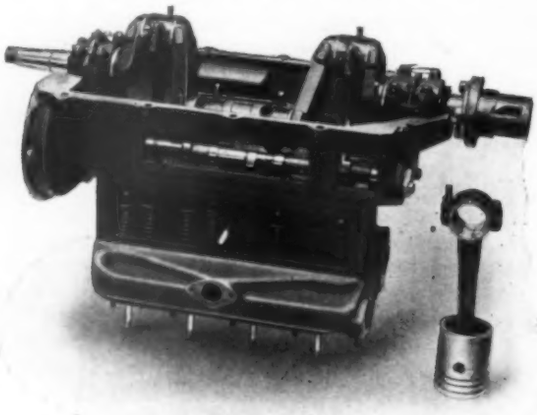


Fig. 2.—View of Engine Partly Assembled.

operation, due to three principal causes: the balanced four-cylinder design, the sensitive oil-bathed governor and the dashpot control. The engine is well housed in and is exceptionally quiet running.

A view of the complete set is shown in Fig. 1, which gives a good idea of the sturdiness and compactness of the general design. Fig. 2 is a view into the interior of the engine which for this purpose before complete assembling has been inverted to disclose the arrangement of the crankshaft and other internal parts. The engine is provided with a starting crank, but an automatic starter can be furnished if storage batteries are used as auxiliary.

The generator is a direct-current machine and designed for whatever voltage is best suited for the conditions. In most cases 32 or 64-volt sets are employed, but for some purposes 110 volts is preferred. This set is also made with flywheel arranged as a pulley for belt driving to the generator, or to any other machine in which mechanical power is to be used directly. As a rule no storage batteries are used with these sets, although they may be installed as an auxiliary, if desired. The size chosen (four kilowatts) has been determined as being the one best suited for average requirements.

Among the uses for which these sets are employed are country-house and summer-resort lighting, lighting of club houses, current supply for motion-picture theaters, lighting of yachts and large motor boats, searchlight work, wireless-telegraph equipments, vehicle charging and miscellaneous battery charging in garages.

Practical Tests of Insulators.

The accompanying illustration (Fig. 1) shows an Ohio Brass Company's three-piece, 35,000-volt, pin-type insulator as it was flashing over on 150,000 volts. This is an example of a practical test made with a high-frequency oscillator.

The oscillator used has an output of 160,000 volts at 200,000 cycles, with an input of 110 volts at 60 cycles, and

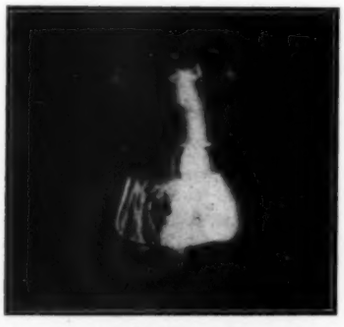


Fig. 1.—Flashover Test on Insulator.

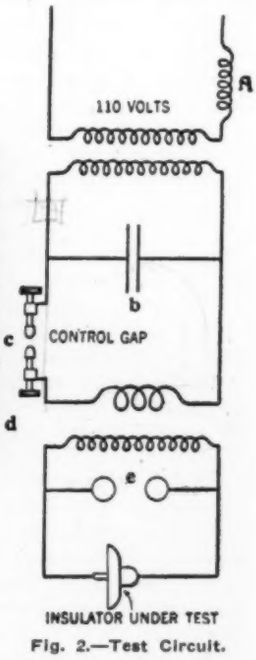
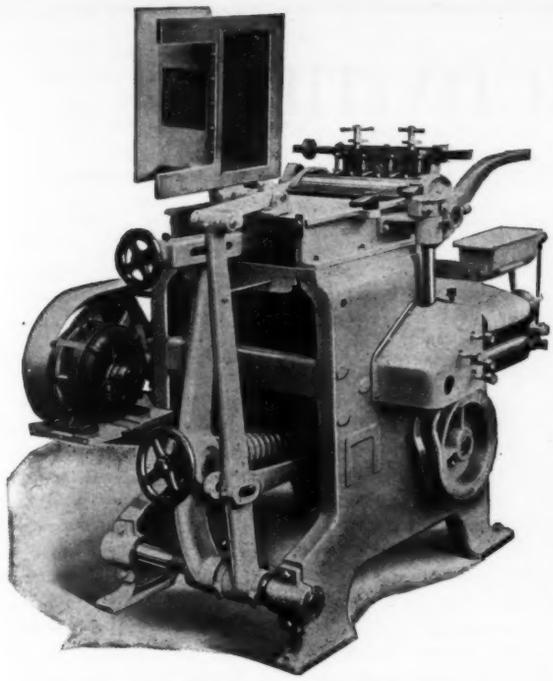


Fig. 2.—Test Circuit.

consists, as shown in Fig. 2, of a 60-cycle, step-up transformer, a condenser, *b*, shunted across the terminals of high-tension winding of this transformer; an adjustable spark gap, *c*, an oscillation or coreless transformer, *d*, the low-tension winding of which is in series with the high-tension winding of the first transformer and adjustable spark gap.

The condenser is charged, and is in turn discharged through the gap, and the coreless transformer, setting up high-frequency wave trains very similar to those experienced in actual transmission under operating conditions. By duplicating line surges and lightning discharges, insulators are subjected to the same stresses they will have in service. The insulator to be tested is placed in series with the high-tension winding on the coreless transformer and the voltage at this point is measured by means of an adjustable sphere gap shown at *e*



Motor-Driven Dough Divider.

The dough is placed in the hopper at the top of the divider, from where it falls into a square box. It is then forced into a cylinder where a knife blade cuts it into loaves. This mechanism can be set to cut loaves of any size. After the cutting operation, the cylinder revolves through a half turn and when in the downward position

Motor-Driven Dough Rounder.

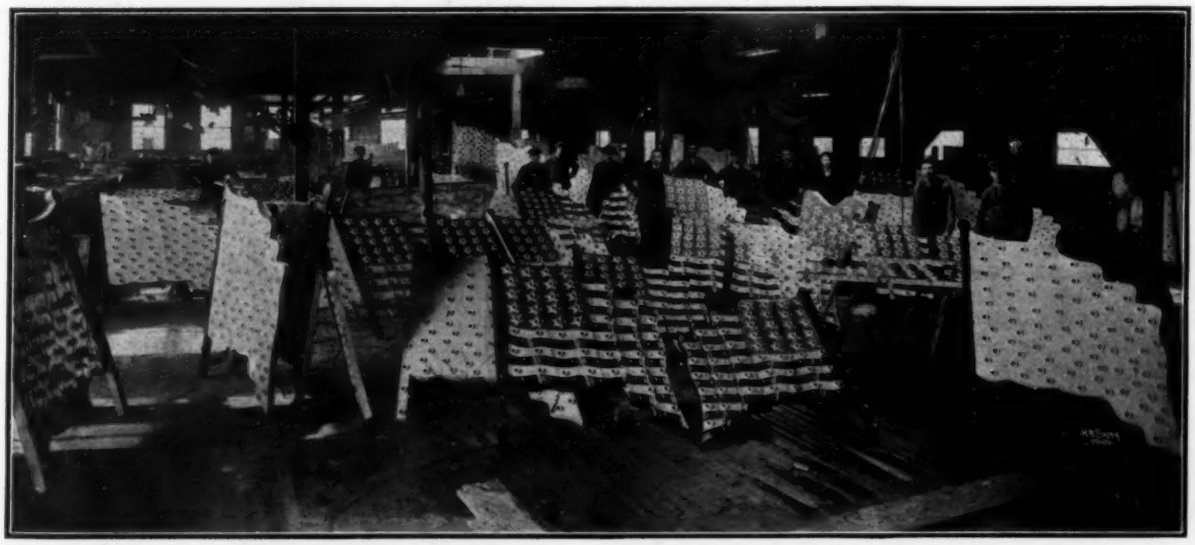
Electrically Operated Bakers' Machinery.

The cleanliness of electric drive adapts it admirably for service in the bakery which makes any pretense at meeting the modern demand for sanitary methods.

A complete line of electrically driven bakers' machinery has recently been developed by the American Bakers Machinery Company, St. Louis, Mo. Two of these machines, the dough divider and rounder, are shown in the accompanying illustrations.

the loaves fall onto an automatic conveyor which carries them to the rounder, where the loaves are shaped up ready for the oven. The divided is made in capacities of 1,800, 2,700 and 3,600 loaves per hour, thus meeting the needs of even the largest bakeries.

Both machines are equipped with Robbins & Myers motors, which are connected through gears. Both the divider and rounder are so constructed that all parts which come in contact with the dough may be easily removed for cleaning.



A View in the Valentine Electric Sign Factory Showing Old Glory Signs.

The Valentine Electric Sign Company, of Atlantic City, N. J., writes as follows regarding electric flag signs: "Our orders for this sign have now reached the thousand mark, coming from every part of the United States, more particularly from the smaller cities than the larger ones and from our inquiries we judge there will be far more sold in the next two or three months than have been heretofore. The flags are made of heavy galvanized sheet steel over angle-iron frames, in exactly the same manner and same equipment as other electric signs. Our flags are all finished in hard enamel colors, the great advantage of which is that even after exposure to the elements, soot, street dirt, etc., they can be wiped off with a damp cloth. The flags sold by ourselves and other manufacturers already represent an entirely new market for hundreds of thousands of lamps, to say nothing of renewals and at the same time being a steady revenue producer for the electric lighting companies. They have been installed in every kind of conceivable place, including public buildings, churches, lodge and meeting rooms of all sorts, factories, picture and legitimate theaters, gymnasiums, in corridors of office buildings and even in private homes. In several different cities public-spirited men and women have bought one or more flags and donated them to public schools, homes of various kinds, women's clubs, etc. There is practically no limit to the sale of these flags and every flag sold aids in the sale of another one."

INDUSTRY ACTIVITIES

George Cutter Company, South Bend, Ind., has issued Catalog No. 13, a 64-page illustrated booklet on street and industrial lighting fixtures.

Crouse-Hinds Company, Syracuse, N. Y. has issued Condulet Bulletin No. 1000F, on fused service-entrance condulets, list prices and discounts being given.

Benjamin Electric Manufacturing Company, Chicago, Ill., has issued a discount sheet applying to its catalog B-21 and subsequent circulars, and effective March 27, 1916.

Main Electric Manufacturing Company, Pittsburgh, Pa., has prepared an illustrated folder showing illustrations of some of its installations of isolated electric lighting and power plants.

Gantz & Leist Electric Company, Cincinnati, O., has issued catalog sheets showing low-speed motors and generators, and high-current motor-generator sets and generators for the deposition of metals.

Schweitzer & Conrad, Chicago, Ill., has issued Bulletin 1A, on extra-high-potential fuses; Bulletin 4, on high-capacity primary cutouts, and Bulletin 5, on type "H" automatic resistance horn arresters.

The Crocker-Wheeler Company, Ampere, N. J., has awarded a contract for the erection of a three-story, reinforced-concrete addition to its plant, about 80 by 100 feet in size, to the American Concrete-Steel Company, Newark, N. J. The structure will cost about $60,000.

The Electric Storage Battery Company, will move its branch office in St. Louis, Mo., April 1, from the Fullerton Building to 1508 Federal Reserve Bank Building. The change is necessitated because of business increases in that territory, which demand larger quarters.

L. O. Beard, an expert watch and clock maker, who for 10 years was connected with one of the largest factories in the United States specializing in electric clocks, will soon open a factory of his own in Lancaster, Pa., for the manufacture of an accurate electrically operated timepiece, perfected by himself.

Minneapolis Electric & Construction Company, Minneapolis, Minn., manufacturer of electrical appliances, is experiencing an increasing demand for its products. Inquiries have been received recently from Odessa, Russia; England, New Zealand and other foreign countries for its patented wire-measuring machine.

Carroll Electric Company, jobbers of electrical supplies and machinery, Washington, D. C., has moved its offices, retail store, and warehouses to the company's new building at 714 Twelfth Street, N. W. The new retail supply store is complete in its appointments, and represents in equipment the result of years of experience in the electrical jobbing business. The company carries a complete stock of supplies, machinery and machine supplies, and does business throughout the South.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued catalog section IP45, on modifications of standard type CS motors, involving motors adapted for conduit wiring, idler pulley, back gearing and other changes; 20-page folder, on installations of Westinghouse switchboards, showing some switchboard, controldesk and switching equipment in recent power developments.

Bright Star Battery Company, manufacturers of Mars-Bright flashlight batteries and the Watchlite, 430 West Fourteenth Street, New York City, has established a branch office in San Francisco, Cal., with Nicholas Abrams as representative. A stock will be carried there to care for the requirements of the trade in that part of the country, placing the company in a position to give the same prompt and efficient service given in the main office in New York City and the branch in Chicago.

Holtzer-Cabot Electric Company, Boston, Mass., is distributing an attractive booklet containing the history of the company since its origin in 1875. The growth of the company during the intervening years has necessitated frequent removals to larger quarters and in 1915 the company moved into its new factory at Roxbury, a six-story reinforced concrete structure containing 148,000 square feet of floor space. The extent of the property is sufficient to allow for additional buildings many times greater than the one just completed, so it is felt that so far as the present generation is concerned, the future expansion of the company is amply provided for.

Bleadon-Dunn Company, 208 North Fifth Avenue, Chicago, Ill., manufacturer of "Violetta" high-frequency generators, has prepared a booklet, which will be sent to all interested, dealing in a clear, understandable manner with the history of violet-ray high-frequency electricity for medical purposes. A considerable portion of the text is devoted to specific instructions for treating various ailments, illustrations being included wherever possible. Testimonials from physicians and users indicate a wide popularity for the Violetta which is now being exhibited in display rooms of a number of central stations. Included in the booklet are descriptions and prices of various combinations of electrodes for treating the scalp, face, throat, body, etc.

Hemming Manufacturing Company, Garfield, N. J., manufacturer of heat-resisting molded insulation, has ready for distribution a very attractive booklet which is of particular interest as it not only deals with the well known products of the company but embodies a pictorial description of the manufacturing processes involved in the production of molded insulation. The plant of this company, which is devoted exclusively to the manufacture of heat-resisting molded insulation, contains 40,000 square feet of floor space and from the views shown in the booklet it is evident that every facility has been provided for efficient and economical operation. An engineering department and a research laboratory are important features of the plant. A rather complete line of connector plugs, sockets, receptacles, heating-device parts, etc., are illustrated, as well as other molded insulation not strictly for electrical use.

Norton & Bird, engineers, have taken into partnership Ezra B. Whitman, of Baltimore, Md., and in addition to their office at 111 West Monroe Street, Chicago, will open offices in the Munsey Building, Baltimore, Md., on April 1, under the firm name of Norton, Bird & Whitman. The firm of Norton & Bird is well known throughout the country, having been engaged in many important electric rate cases. The firm has also just completed a valuation of both the gas and electric properties of the Union Gas & Electric Company, Cincinnati, O., and among the important rate cases are those of the Commonwealth Edison Company, Chicago; New York Edison case on the behalf of the Merchants' Association of the City of New York; Indiana & Michigan Electric Company, South Bend, Ind., and the Indianapolis (Ind.) Light & Heat Company. The new firm will specialize in valuation and rate work.

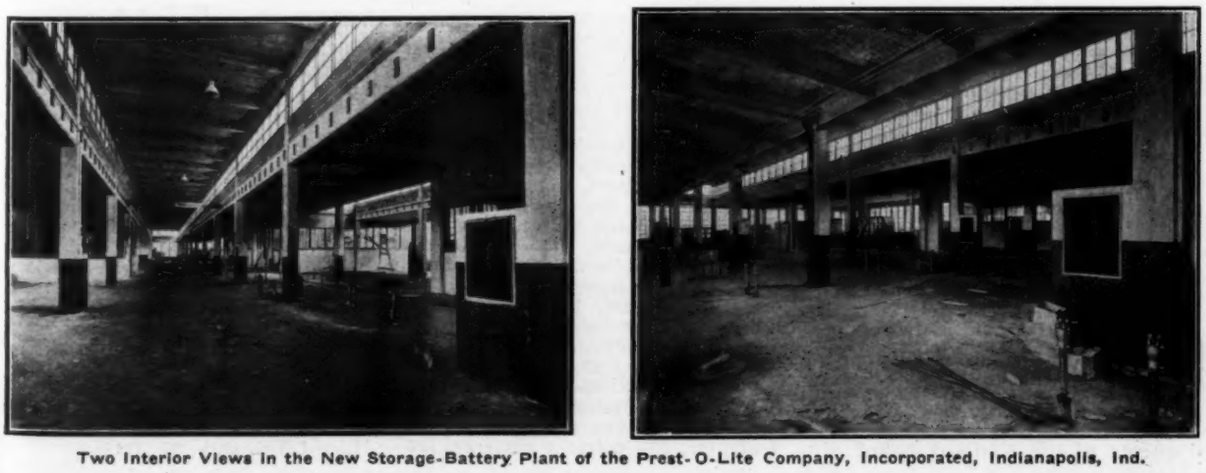
Mica Insulator Company, 68 Church Street, New York City, has issued a booklet on its Conducell method of insulating the cable joints in underground transmission systems. Each conductor is separately incased and thoroughly protected. The simple method of making the joints is explained and illustrated. The company also has published a booklet on Conduline, a compound of high insulating qualities for filling the joints of cables. It is particularly adapted for use with Conducell insulation.

Electric Machinery Company, Minneapolis, Minn., has orders on hand for more business than at any other time in the company's history. Among the larger contracts recently closed is one for two 625-kilowatt alternators, exciters and switchboard equipment for the Northwest Paper Company, Brainerd, Minn.; two 450-kilowatt alternators, one 40-kilowatt generator and accessories for the Kimberly-Clark Company's Paper Mill, Neenah, Wis.; three 6,600-volt synchronous motors for driving 250-horsepower air compressors at the Illinois Steel Company's plant, Joliet, Ill., and generating equipment for the municipal plant at Three Rivers, Mich.

Domestic Engineering Company.—The field to be covered by the Domestic Engineering Company, of Dayton, O., recently organized as a part of the Dayton Engineering Laboratories Company, was explained in detail by R. H. Grant, general manager of the new company, at a Jovian meeting in Dayton recently. Mr. Grant pointed out that there are 6,000,000 farm families in the United States, and, including them, about 70,000,000 people who are not reached by the lines of any electric company. The electric generator set manufactured by the Domestic Engineering Company is intended to meet the needs of these people. It consists of an air-cooled gas engine, direct-connected to a generator, of a size to meet the needs of farmers and others for limited power and lighting purposes. Mr. Grant stated that the company will also market electrical appliances for domestic use, such as irons, washing machines, vacuum cleaners, and the like, at least for the present, for the purpose of making its service as nearly complete as possible. As the company's business will come from persons not now accessible to the ordinary light and power company, he pointed out that it will not in any sense compete with any other concern, but will develop an entirely new field.

The Wagner Electric Manufacturing Company has begun construction on two new buildings adding to its present factory group on Plymouth Avenue, St. Louis, Mo. One building is to be 140 by 90 feet, with a 50-foot open bay spanned by an electric traveling crane, and galleries 20 feet in width on either side of the bay. The building, which will be used for punch-press operations, will be structural steel with all-metal roof and longitudinal skylight down the center. The other building will be 160 by 90 feet, of reinforced concrete fireproof construction. It will be used for various operations involving the production of small parts, including small punch-press work. The new buildings will be connected by a tunnel with the main section of the company's No. 1 plant. Contracts call for the completion of the first building by April 21 and the second by June 2. The Condron Company, Chicago, Ill., designed both buildings, and the reinforced concrete floors of the second building will be of the patented "Acme System" of that company. Nearly all the exterior wall area of both buildings is glass, which insures excellent daylight working conditions on every floor.

Prest-O-Lite Company, Incorporated, Indianapolis, Ind., has practically completed its new storage-battery building. It is 400 feet long by 100 feet wide and is the second largest building of the present factory group. It has excellent facilities for a large output and when placed in operation a production of 1,200 batteries a day will be possible; the present output of Prest-O-Lite batteries is 400 a day. Plenty of provision has been made for future expansion, although for the present every foot of floor space will be utilized to the highest degree. The building in general is one story in height with a monitor roof. There are, however, two rooms on the second floor, each 50 by 50 feet in size, one of which will be used for a welfare room, containing shower baths, lockers and lunch rooms. The other will be used for shop office and laboratory. The construction throughout is reinforced concrete. Floors in half the buildings are of concrete and the other half of brick and asphalt which are not affected by the action of acids; the roof is of reinforced concrete with a layer of rock cork under the roofing as an insulation against sun heat. Plenty of daylight is provided for, 70 per cent of the wall space being windows. At one side of the building there is a shipping platform of concrete, 12 feet wide and 400 feet long; side-track connections with two railroads are provided. On the roof of the new building there is a fan room containing a fan, air washer and steam heating coils. From this a shaft connects with a tunnel running lengthwise through the building under the floor. This is the main distributing tunnel for supplying washed, filtered and warmed or cooled air to the various parts of the building. In addition to the ample supply of washed air supplied to these rooms, exhaust fans will be installed to perfect the ventilation. Floor drains have been located at intervals of about 20 feet and numerous hose outlets are provided so that the floors can be entirely washed down every day. Wash sinks will be located at frequent intervals throughout the building and provided with mixing faucets so arranged that employees will be forced to wash in warm running water; many drinking fountains will be located about the building, supplied with cooled waters from a well 450 feet deep.



Two Interior Views in the New Storage-Battery Plant of the Prest-O-Lite Company, Incorporated, Indianapolis, Ind.

LATEST APPROVED FITTINGS

The electrical fittings illustrated and described in this department have been approved by the Underwriters' Laboratories, Incorporated, following examination and tests conducted under standards of the National Electrical Code as recommended by the National Fire Protection Association

ATTACHMENT PLUGS, Fuseless.—Russell & Stoll Company, 48 Cliff Street, New York, N. Y.

Russell & Stoll connector, 15 amperes, 250 volts, catalog No. 95.

Listed February 16, 1916.

BOXES, Floor Outlet.—M. B. Austin & Company, 700 Jackson Boulevard, Chicago, Ill.

Cast-iron, water-tight floor outlet boxes, with Hubbell receptacles and with floor plates and nozzles.

"A" 10 amperes, 250 volts, catalog Nos. 100 and 1100.

Listed February 9, 1916.

BUSHINGS, Outlet.—M. B. Austin & Company, 700 Jackson Boulevard, Chicago, Ill.

Malleable cast-iron bushings, type A.

Listed February 11, 1916.

CONDUIT BOXES.—W. A. Bonnell Company, 132 Church Street, New York, N. Y.

Cast-iron boxes for armored cables and flexible steel conduits. Types A, B, C and D.

Listed February 14, 1916.

GROUND CLAMPS.—W. A. Bonnell Company, 132 Church Street, New York, N. Y.

Ground clamp, consisting of a punched copper strap, with formed soldering lug, a bolt, and two specially formed cast clamping pieces. Sizes up to 6 inches. Catalog Nos. 815, 820, 825, 830, 835, 840.

Listed February 16, 1916.

HEATERS, Electric—The Dover Manufacturing Company, Canal Dover, O.

Electric flat irons, 550 watts, 95-125 volts, two types.

Dover 6-D, with separable cord.

VEA, with attached cord. Old style.

Supplied with sheet-steel stands.

Listed February 16, 1916.

INCUBATORS AND BROODERS, Electrically Heated.—Lo-Glo Electric Incubator Company, Incorporated, 76 Greenwich Street, New York, N. Y.

Lo-Glo electric incubators and hovers. Incubators; maximum watts, 180; maximum volts, 250; catalog Nos. 500, 650, 850, 1200, 1600, 2100, 3100 and 4200. Hovers; maximum watts, 90; maximum volts, 250; catalog Nos. 200, 201 and 202.

Listed February 18, 1916.

PANELBOARDS. — Metropolitan Electric Company, 324 First Avenue South, Seattle, Wash.

Panelboards shown by tests and examinations by Underwriters' Laboratories to be in accordance with the requirements of the National Board of Fire Underwriters have labels attached. Laboratories.

Listed February 9, 1916.

RECEPTACLES, Standard. — The Connecticut Electric Manufacturing Company, Bridgeport, Conn.

Porcelain shell, C. E. M. Co. Keyless, 660 watts, 250 volts, catalog No. 11035.

Brass shell. Key, 660 watts, 250 volts, catalog No. 12025. Keyless, 660 watts 250 volts catalog No. 12026.

Listed February 15, 1916.

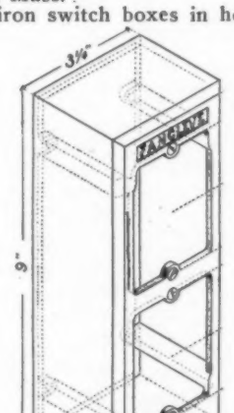
SWITCH BOXES.—M. B. Austin & Company, 700 Jackson Boulevard, Chicago, Ill.

Single and sectional gang, Austin, catalog Nos. 1000-1004 inclusive.

Listed February 12, 1916.

SWITCH BOXES.—Fancleve Specialty Company, Jamaica Plain Station, Boston, Mass.

Cast-iron switch boxes in horizontal



Switch Box.—Fancleve Specialty Company.

and vertical tandem styles, Fancleve. Catalog Nos. 512-14, inclusive; 571-97, inclusive.

Listed December 31, 1915.

SWITCHES, Combination Cutout.—Connecticut Electric Manufacturing Company, Bridgeport, Conn.

C. E. M. Co. Branch-circuit panel switches, 30 amperes, 250 volts, catalog Nos. 20030 and 20130.

Knife switches with clips for 30-ampere, cartridge-inclosed fuses, so arranged that fuses lie under switch blades, connection being made through straps sealed in under side of base.

Listed February 15, 1916.

SWITCHES, Fixture.—Weber Electric Company, Schenectady, N. Y.

1 ampere, 250 volts; 3 amperes, 125 volts; with key and pull-socket mechanisms.

Brass shell. Key, catalog Nos. UA101-UA103, UA105-UA109, UA111-UA115. Candle, key, catalog Nos. UD101-UD103, UD105-UD109, UD111-UD115, UD117-18, ED201-ED203, ED205-ED209, ED211-ED215. Pull, catalog Nos. UB101-UB103, UB105-UB109, UB111-UB115, EC201-EC203, EC205-EC209, EC211-EC215, UF101-UF103, UF105-UF109, UF111-UF115, Candle, pull, catalog Nos. UE101-UE103, UE105-UE109, UE111-UE115, UE117-UE118, EE201-EE203, EE205-EE209, EE211-EE215.

Porcelain shell. Key, catalog Nos. PA301-PA304, PA309-PA310. Pull, catalog Nos. PC301-PC304, PC309-PC310, PF301-PF304, PF309-PF310.

Listed January 31, 1916.

SWITCHES, Pendant Snap.—Weber Electric Company, Schenectady, N. Y.

1 ampere, 250 volts; 3 amperes, 125 volts; with key and pull-socket mechanisms.

Brass shell. Key, catalog Nos. UA117-18. Pull, catalog Nos. UB117-18, UC117-18, through type UF117-18.

Porcelain shell. Key, catalog Nos. PA117-18. Pull, catalog Nos. PB117-18, PC117-18, through type PF117-18.

Listed January 29, 1916.

SWITCHES, Surface Snap.—Weber Electric Company, Schenectady, N. Y.

1 ampere, 250 volts; 3 amperes, 125 volts, with key and pull socket mechanisms.

Brass shell. Key, catalog Nos. UA212-UA139, UD212-UD139. Pull, catalog Nos. UB121-UB139, UE121-UE139.

Porcelain shell. Key, catalog Nos. PA321-PA334, PA337, PA339. Pull, catalog Nos. PB321-PB334, PB337, PB339.

Listed January 31, 1916.

SWITCHES, Surface Snap.—Weber Electric Company, Schenectady, N. Y.

Ceiling switches (pull type). With metal covers. Single pole, 1 ampere, 250 volts; 3 amperes, 125 volts; catalog Nos. UC121-UC139.

With porcelain covers. Single pole, 1 ampere, 250 volts 3 amperes, 125 volts; catalog Nos. PC321-PC334, PC337, PC339.

Listed January 29, 1916.

WIRES, Slow-Burning. — American Insulated Wire & Cable Company, Twenty-first and Morgan Streets, Chicago, Ill.

Tag on coil to read: "National Electrical Code Standard."

Marker: One red and one green thread *crossing* in intermediate layer of braid.

Listed February 15, 1916.

PERSONAL AND BIOGRAPHICAL

MR. F. O. GODFREY, formerly with Sanderson & Porter, consulting engineers, Chicago, Ill., has joined the staff of the testing department of the Public Service Company of Northern Illinois.

MR. F. W. BUCK, who has been associated with the Union Electric Company, Pittsburgh, Pa., during the past eight years, serving in the capacities of chief clerk, purchasing agent and advertising manager, has accepted a position with the Hurley Machine Company, of Chicago, Ill., and will represent that company in the Pittsburgh territory. Mr. Buck assumed his new duties April 1.

MR. C. H. UTTER, manager of the Grinnell (Iowa) Electric Light & Heating Company, has been elected a member of the board of directors and made western manager of the Iowa Light, Heat & Power Company, recently incorporated in Iowa, with headquarters at Grinnell. The latter company is the owner of 23 district electric utility companies in Iowa, including the Grinnell company, and is capitalized at $1,000,000.

MR. FRANK S. WASHBURN has resigned as chairman of the board of directors of the Alabama Power Company, Birmingham, Ala., and as a director of the Alabama Traction, Light & Power Company, the Muscle Shoals Hydro-Electric Power Company, the Alabama Interstate Power Company and other subsidiaries. It is understood Mr. Washburn will devote his time to the American Cyanamid Company, of Niagara Falls, N. Y., of which company he is president.

MR. C. S. HARRIMAN has entered the employ of the Wagner Electric Manufacturing Company in its branch office in Kansas City, Mo. Mr. Harriman was with the Home Telephone Company and the Kansas City Electric Light Company until 1913 when he was placed in charge of the contract department of the newly established municipal lighting plant of Kansas City, Kans. Since that time he has been instrumental in promoting the large industrial use of electricity in that city.

MR. ARTHUR C. KING has resigned his position as deputy commissioner of gas and electricity of the city of Chicago and has opened a consulting-engineering office in the Hartford Building, Chicago. Mr. King is a native of New York State. He was graduated from the mechanical engineering department of the University of Wisconsin in 1901, and later obtained from it also the degree of E. E. Until 1907 he was associated with the Northern Electric Company, of Madison, Wis., in various capacities, the last two years as assistant chief engineer. He then came to Chicago and represented some manufacturing interests and later took up consulting work on efficiency studies, valuations and reports. In 1911 he was associated with Mr. Ray Palmer on an electrolysis investigation in Chicago and in the next year on the Commonwealth Edison rate question. In 1913 he became deputy commissioner of gas and electricity under Mr. Palmer. During the last few years he has also made valuations of the plants of the Illinois Telephone & Telegraph Company, Chicago, and the Union Gas & Electric Company, Cincinnati.

MR. LUDWIG KEMPER, who was elected president of the Minnesota Electrical Association at its annual convention last week, is secretary-treasurer and manager of the Minnesota Gas & Electric Company, of Albert Lea, Minn. Mr. Kemper was born in 1877 in Rotterdam, Holland. He was graduated as mechanical engineer from the University of Delft, Holland, and later took post-graduate work in electrical engineering at the University of Karlsruhe, Germany. After working as an industrial engineer, in Europe two years, he came to the United States in 1902, accepting a position in the engineering department of the Pullman Company, being identified with work on electric car lighting. In 1903 he

Ludwig Kemper.

was appointed assistant electrical engineer for the Baltimore & Ohio Railroad, continuing with that company until 1905, when he became general manager of the Minnesota Gas & Electric Company. Mr. Kemper was secretary of the Minnesota Electrical Association during 1908 and president during 1911.

MR. SYDNEY O. SWENSON, formerly electrical engineer for the Kansas City (Mo.) Terminal Railway Company, has become a member of the engineering offices of Putnam A. Bates, 2 Rector Street, New York City. Mr. Swenson received his early education in the grammer and manual-training schools of Chicago, Ill., and was graduated from the University of Illinois in 1899. From the time of his graduation until 1905 he was in the engineering department of the Commonwealth Edison Company and was engaged in the general engineering work in connection with the expansion of the company during that period. From 1905 to 1907 Mr. Swenson was employed by the New York Central & Hudson River Railroad Company in the electrification of that company's road in New York City. From 1907 to 1911 he was assistant electrical engineer of the Detroit River Tunnel Company and was engaged in the engineering work in connection with the electrification of the Michigan Central Railroad at Detroit, Mich., and Windsor, Ont. In 1911 Mr. Swenson was appointed electrical engineer for the Kansas City Terminal Company and had charge of the electrical work pertaining to the new Union Station and terminal facilities at Kansas City. Mr. Swenson assumed his new position March 15, and his wide experience will undoubtedly prove a very valuable asset in the engineering offices of Mr. Bates.

OBITUARY.

MR. JOHN L. BOROUGHS, district plant chief of the Southern Bell Telephone Company, died recently at Birmingham, Ala., from injuries received in an automobile accident. Mr. Boroughs had been connected with the Southern Bell Company for 22 years.

MRS. MARY L. THOMSON, wife of Prof. Elihu Thomson, died March 19 at her home in Swampscott, Mass., aged 60 years. She was married in 1884 to Professor Thomson, who, with four sons, survives her. Stuart and Roland Thomson are connected with the General Electric Company at Schenectady, N. Y.; Malcolm Morrison is engaged in electrical work in Lowell, Mass., and Donald Thomson is a student living at Swampscott.

MR. OSCAR F. GUNZ, a well known patent lawyer of New York City, died at his home in Rutherford, N. J., aged 62 years. Mr. Gunz was born in New York City and received his education at College of the City of New York and at Hanover University in Germany. He was one of the engineers who planned the Sixth Avenue "L" stations in New York City. He was employed in the United States Patent Office for several years.

DR. C. J. H. WOODBURY, a widely known engineer, lecturer and historian, died at his home in Lynn, Mass., March 20. He was born in that city in 1851, was graduated from Massachusetts Institute of Technology in 1873, became an engineer and later vice-president of the Manufacturers' Mutual Fire Insurance Company. He was active in the affairs of the National Electric Light Association in its first decade, and made exhaustive studies of electric lighting, lubricating oils, and measures for fire prevention, during which time he was a regular contributor to this journal. In 1894 he became assistant engineer for the American Bell Telephone Company, continuing with that company until 1907. Among other organizations, Dr. Woodbury was a member of the American Institute of Electrical Engineers. For the preparation of insurance rules on electric lighting he received the John Scott medal. He held honorary degrees from Tufts, Union and Dartsmouth Colleges.

CURRENT ELECTRICAL NEWS

Weekly Record of Construction Activities

EASTERN STATES.

LISBON, ME.—City officials here are considering a plan to erect a municipal power plant. While no definite plans have been made, there is talk of making a hydroelectric development on the Androscoggin or the Sabattus River.

NEW LONDON, N. H.—The Sunapee Electric Light & Power Company has installed street lighting in this town. A considerable amount of house and commercial wiring is being done.

LONGMEADOW, MASS.—This town has voted to have its streets lighted by electricity and has appropriated $3,100 for the purpose. About 210 incandescent lamps will be installed, the United Electric Light Company of Springfield furnishing the service.

NEWBURYPORT, MASS.—The Newburyport Gas & Electric Company is doing the preliminary work necessary for the construction of a large power plant to be built in the near future.

WEBSTER, MASS.—An appropriation of about $2,000 will probably be made by the Town Council. It is proposed to install 31 luminous arc lamps on ornamental posts.

PROVIDENCE, R. I.—The city's new contract for street lighting calls for the placing of all wires underground. The work will be begun in the early spring. Three miles of street wiring in the southern and southwestern part of the city will be placed underground as the first installment.

WESTERLY, R. I.—The Westerly Light & Power Company has made application to the State Legislature for authority to increase its capital stock from $700,000 to $1,000,000. Extensions are planned.

TORRINGTON, CONN.—An electric line, in which A. J. Patton & Company, of Waterbury, is interested, will be constructed during the summer between this place and Waterbury, via Litchfield, Bantam, Morris and Watertown, 22 miles, at an estimated cost of $1,000,000.

FULTON, N. Y.—The third and last waterwheel of the Oswego Falls Pulp & Paper Company's new hydroelectric plant has recently been installed. Two of the three 2,200-horsepower vertical-type waterwheels have been in operation for several weeks. The American Woolen Company is making preparations to install another waterwheel in its plant on the other side of the river.

NEW YORK, N. Y.—The Interborough Rapid Transit Company will build a one-story substation, 60 by 100 feet, on River Avenue near 162nd Street, to cost about $40,000. Plans are on file with George H. Pegram, architect, New York City.

PARKSVILLE, N. Y.—An electric generator will be installed in the new commercial building to be erected on Main Street by Edwin A. Cammen. M. J. Nadel, Newark, N. J., is the architect.

SILVER CREEK, N. Y.—The Peoples Electric Light & Power Company has submitted to the Council a proposition to furnish energy for street lighting here.

TONAWANDA, N. Y.—Application for a franchise to furnish electric service here has been received by the Town Board from the Buffalo General Electric Company.

WATERTOWN, N. Y.—An ornamental lighting system is proposed for Factory Street by property owners and businessmen.

BUTLER, N. J.—The Pompton Township Committee has granted the Butler municipal electric lighting plant a 20-year franchise to install and operate a system in the township.

HIGHTSTOWN, N. J.—The Hightstown Electric Light & Power Company is planning improvements and extensions in its system.

HOBOKEN, N. J.—The Public Service Electric Company is negotiating with the Board of City Commissioners for the installation of an underground conduit system along River Street.

NEWARK, N. J.—The Common Council has approved plans for the installation of a new semi-direct electric lighting system in the city hall. Hooper & Company are the architects.

TRENTON, N. J.—The Board of Freeholders is planning for the installation of a new electric lighting system in the county court house.

TRENTON, N. J.—Governor Fielder has signed a bill authorizing the establishment of a new white way lighting system in Trenton.

HIGHSPIRE, PA.—The Council is collecting data concerning the installation of a street lighting system in the borough.

MARION, PA.—D. S. Martin and others have applied for charters granting permission to serve this township with energy for power and lighting. Another charter for Tulpehocken township has been applied for by Mr. Martin and associates.

NEW BRIGHTON, PA.—Plans for a white way and rearrangement of the borough lighting system, which were prepared by H. O. Swoboda, consulting engineer, Pittsburgh, Pa., are being considered by the Council.

NEW OXFORD, PA.—The Town Council has granted a franchise to the Hanover (Pa.) Light, Heat & Power Company for supplying electrical energy for street lighting.

SWATARA, PA.—The Swatara Electric Company has made application to the Public Service Commission for a charter to operate here.

TOPTON, PA.—The Topton Electric Company has been organized by Laurence B. Myers for the purpose of furnishing electric service to this borough.

WASHINGTONBORO, PA.—The City Council is considering an ordinance providing for the establishment of an electric lighting and power plant here.

WAYNESBORO, PA.—A white way system on Main Street is being advocated by business men of the city.

DOVER, DEL.—The Town Council is considering an expenditure of about $10,000 for the municipal power plant. A 200-kilowatt, engine-driven generator may be purchased.

HAGERSTOWN, MD.—Plans for a white way here are being considered by city officials.

RISING SUN, MD.—A bill providing for a bond issue to pay for the construction of an electric lighting plant has passed the senate.

BELPRE, W. VA.—A proposition by the Kanawha Traction & Electric Company, P. P. Crafts, general manager, to furnish energy for street lighting and commercial purposes is being considered here.

ORANGEBURG, S. C.—The Parr Shoals Electric Power Company is planning to extend its lines to this city. Plans have been nearly completed for a municipal plant on a site near the Edisto River, but may be abandoned if satisfactory arrangements can be made with the power company.

CORDELE, GA.—C. F. Wagner, city engineer, is preparing plans for the construction of a municipal electric lighting and waterworks plant, to cost about $50,000.

JUNCTION CITY, GA.—The city is contemplating the construction of an electric lighting plant.

RINGGOLD, GA.—D. Ferriss will improve and enlarge the electric lighting plant here, which he purchased from M. L. Harris.

BROOKSVILLE, FLA.—The Brooksville Electric Light & Water Company has been granted a franchise for furnishing electric service here.

ST. PETERSBURG, FLA.—The St. Petersburg Lighting Company, G. W. Wilson, manager, will spend about $75,000 for improvements to its electric lighting plant.

WEBSTER, FLA.—Welborn, Zeller & Welborn, of Detroit, Mich., have been granted a franchise to establish an electric lighting plant here.

NORTH CENTRAL STATES.

AKRON, O.—By the decision of the United States Supreme Court affirming the rights of the Cuyahoga River Power Company to the use of the river for power purposes, as against the city, the way has been cleared for the company to proceed with its plans for the construction of a large hydroelectric plant.

CANTON, O.—The lighting committee of the City Council, Ralph Staley, chairman, expects that bids will be asked on side lighting in the downtown district within a week. Bids on electric and gas side lights of various types will be received.

GALLIPOLIS, O.—New construction is planned by the Gallipolis Light & Power Company, recently incorporated by John P. Phillips and others with a capital stock of $25,000.

LONDON, O.—The inadequacy of the city lighting plant will make necessary either a considerable amount of remodeling work, estimated at from $17,000 to $20,000, or other arrangements for securing service. The Ohio Electric Railway Company has made a proposal to sell energy to the city at a low rate, and to erect a substation with the necessary equipment in connection with the distributing system. The City Council is considering these plans, as well as offers from several sources to buy the city plant and bring it up to date.

MASSILLON, O.—Plans for a new street-lighting system are being considered by W. C. Koons, chairman of the light committee of the City Council, and by T. O. Kennedy, general manager of the Massillon Electric & Gas Company.

MT. ORAB, O.—A transmission line nine miles long and a local distributing plant will be constructed by the town, a bond issue of $4,000 having been approved for that purpose.

NEWTOWN, O.—The question of issuing $7,000 electric light bonds will be submitted to vote in April.

SPRINGFIELD, O.—It has been decided to call for bids, to be opened on April 13, for the construction of the city's new boulevard lighting system. The contract will be awarded about May 1.

TIFFIN, O.—The City Council has declared its intention of throwing open to bids proposals for private lighting in the city. This is in addition to the street lighting contract.

COLUMBUS, IND.—The Sanborn Electric Company, Indianapolis, has been awarded a contract for a new city electric light plant to be equipped and constructed at a cost of $16,000. The city is now lighting the streets and will enter the commercial field when the new plant is completed.

EVANSVILLE, IND.—Congressman C. B. Smith and a party of capitalists from Buffalo, N. Y., have been in conference with the Chamber of Commerce officials in regard to electrical service. They are interested in the project to establish a hydroelectric plant at Mt. Carmel, Ill., on the Wabash River.

UNION CITY, IND.—A new boulevard lighting system is being planned for Union City. According to plans, the white way district will include all of the business district and 60 ornamental posts are to be erected. Nitrogen lamps will be installed in the residence district.

WESTPORT, IND.—A bond issue of $5,000 has been voted for the establishment of a municipal electric lighting plant.

BLOOMINGTON, ILL.—The Bloomington & Normal Railway & Light Company, M. G. Linn, general superintendent, will build a 33,000-volt transmission line from Lexington to Chenoa, a distance of nine miles; install a substation in Lexington and rebuild the distribution system there, to operate at 2,300 volts, three-phase, stepped down to 110 and 220 volts. The company will also do some track work during the summer.

CHAMPAIGN, ILL.—The Urbana & Champaign Railway, Gas & Electric Com-

pany, H. J. Pepper, general superintendent, is planning to install during the coming year a 2,500-kilowatt turbogenerator, 1,000 horsepower in boilers, and boiler feed pump.

CHICAGO, ILL.—Nine street car line extensions were recommended to the City Council by the committee on local transportation. These extensions probably will be ordered during the present year.

DIXON, ILL.—The Illinois Northern Utilities Company, E. D. Alexander, vice-president, has recently completed a transmission line from Capron to Poplar Grove, the plant at the latter place having been purchased by the company. A transmission line will be built during the early summer from Tampico to Walnut and Ohio to serve those cities.

GALESBURG, ILL. — Improvements to this city's municipal street lighting plant and system estimated to cost $25,018 are advocated in a report just completed by M. Ferry, a consulting electrical engineer of Chicago, and John Walsh, superintendent of water and electric lights.

GRANVILLE, ILL.—The Putnam County Electric Company has been incorporated with a capital of $30,000 by Sidney Whitaker, G. W. Hunt and others.

HOMER, ILL.—The Homer Electric Light & Power Company's holdings have been sold to the William B. McKinley interests, of Champaign. The local plant probably will be discontinued and power secured from the lines of the Illinois Traction Company.

MURRAYVILLE, ILL.—The Central Illinois Public Service Corporation has secured a franchise option for supplying electrical energy to this town.

ROCKFORD, ILL.—The Rockford Electric Company, Adam Gschwindt, general manager, will install during the coming year a 6,250-kilowatt turbogenerator, a 1,000-kilowatt motor-generator set, 1,000 horsepower in boiler capacity, additions to its water-softening plant, and will make extensions to its distribution lines costing about $50,000.

STREATOR, ILL.—An estimate for the installation of a fire and police-alarm system has been completed by H. G. Young, city electrician. The cost is $3,144.65.

WEST FRANKFORT, ILL.—All preliminaries pertaining to the construction of the new Schott electric line connecting Harrisburg, Marion, Johnston City, Benton and West Frankfort have been completed and work will commence soon after April 1.

DETROIT, MICH.—A $1,000,000 corporation, the stock of which has been fully subscribed by Robert Oakman, Mayor Oscar B. Marx, L. W. Tuller and a few others, will build a car line from Dearborn to Highland Park, with a view to connecting the Ford plants, the motor-car factory in Highland Park and the tractor factory planned for Dearborn, and to furnish car service between the Michigan, Grand River, Hamilton and Woodward lines.

LAWRENCE, MICH.—Following an estimate furnished by Engineer Dan P. Smith of Paw Paw, the Village Council has decided to submit to the voters the proposition of a municipal electric lighting plant. A special election will be held this week.

PONTIAC, MICH.—Plans are being made by the City Commission to extend the boulevard lights on several streets in the business section this spring. Commissioner McLintock of the department of public utilities, is aiding the work.

SAULT STE. MARIE, MICH.—The Great Lakes Power Company, which was recently incorporated, is understood to have acquired the hydroelectric plant of the Algoma Steel Company at Sault Ste. Marie, one of the subsidiaries of the Lake Superior Corporation, and also the street railway system in the Canadian Soo and the international ferry, controlled by the same interests. Plans of the new company include the expenditure of $3,000,000 on the properties and the development of 30,000 horsepower additional at the hydroelectric generating station.

LOMIRA, WIS.—The Lomira Electric Light & Power Company, A. E. Carpenter, engineer, is planning to remodel its power plant, to include the installation of new generating equipment.

NEW LONDON, WIS.—A contract has been signed by the Light Commission and Zerrenner Brothers for furnishing power at the latter's brick yards. The lines of the municipal plant will be extended to the yards at a cost of about $1,400.

OGEMA, WIS.—Plants are being considered for the installation of a municipal electric lighting system here.

WINTER, WIS.—James Feeley, of Fifield, and others are interested in a plan to establish an electric lighting plant here.

DATES AHEAD.

American Society of Mechanical Engineers. Spring meeting, New Orleans, La., April 11-14. Secretary, Calvin W. Rice, 29 West Thirty-ninth Street, New York City.

American Electrochemical Society. Semi-annual meeting, Washington, D. C., April 27-29. Secretary, J. W. Richards, Lehigh University, South Bethlehem, Pa.

Iowa Section, N. E. L. A. Annual meeting, Dubuque, Iowa, May 10-12. Secretary, W. H. Thompson, Jr., Des Moines, Iowa.

Missouri Association of Public Utilities. Annual convention, May 11-13, on board boat leaving St. Louis May 11. Secretary, F. D. Beardslee, 315 North Twelfth Street, St. Louis, Mo.

Southwestern Electrical and Gas Association. Annual convention, Galveston, Tex., May 17-20. Secretary, H. S. Cooper, 405 Slaughter Building, Dallas, Tex.

National Electric Light Association. Annual convention, Chicago, Ill., May 22-26. Secretary, T. C. Martin, 29 West Thirty-ninth Street, New York City.

Arkansas Association of Public Utility Operators. Annual convention, Little Rock, Ark., June 6-8. Secretary, R. B. Fowles, Pine Bluff, Ark.

National Electrical Contractors' Association of the United States. Annual convention, Hotel McAlpin, New York City, July 18-22. Secretary, G. H. Duffield, 41 Martin Building, Utica, N. Y.

NEWTON, IOWA.—The Des Moines Street Railway Company, Emil Schmidt, president, will extend its lines from Colfax to Newton this year.

ATCHISON, KANS.—Fire caused $4,000 damage to power plant of the Atchison Railway, Light & Power Company recently.

FOWLER, KANS.—The work of repairing the municipal electric lighting plant is nearing completion, and this city will again have adequate service.

GARDEN CITY, KANS. — The engine room of the Garden City Telephone, Light & Manufacturing Company, C. E. Marsh, manager, was destroyed by fire recently. Repairs are being made.

FLANDREAU, S. D.—The Dakota Light & Power Company, A. H. Savage, treasurer, is contemplating the installation of a 200-kilowatt generating unit, driven by a gas engine.

DODGEN, N. D.—Petitions are being circulated for the erection of an electric lighting plant here.

FOREST RIVER, N. D.—A plant is to be constructed to supply electrical energy to the city as well as the farms in Forest River, a stock company having been organized by Otto Bhend, H. G. Hager and others with a capital of $10,000.

LANSFORD, N. D.—The Northern Telephone Company is contemplating installing a new generating unit, consisting of a generator and an internal combustion engine.

PETERSBURG, N. D.—M. O. Topen has asked for a franchise to install and operate an electric lighting plant here. The Village Trustees probably will grant the request.

SHERWOOD, N. D.—E. T. Clark and J. Van de Eroe have purchased the local electric lighting plant from C. H. Budke. Improvements will be made.

SOUTH CENTRAL STATES.

BARBOURVILLE, KY.—The stock and equipment of the Barbourville Electric Company was damaged by fire recently.

ADAMS, TENN.—An ordinance granting a franchise to the South Kentucky Power Company to furnish lighting for the town has been passed by the Town Council.

ALEXANDRIA, TENN.—Work on the construction of the Nashville & Eastern Interurban Railroad, of which C. T. Edwards is president, is expected to begin within the next month. The road is to be built from Smithville to Lebanon.

DANDRIDGE, TENN.—Sale by the receiver of the Dandridge Power & Light Company's plant has been confirmed and the new owners, W. A. Lyle and Joseph Baker, will improve the property with a water power addition. A dam will be constructed on Felknor Creek three miles from town which will furnish ample power not only for the customers of the company but for various industries.

KINGSPORT, TENN.—The Oliver-Hill Construction Co., Knoxville, has been awarded a contract for excavating, concrete work and installing machinery at $30,000, part of the work to be on the power plant and pumping station to be erected here. Power will be supplied for a cement mill, dye plant, and other industries.

LIVINGSTON, TENN.—The Livingston Light & Power Company has been organized with S. O. Kennedy president, and will install a waterwheel and generating equipment at the falls at Crawford Mills.

MURFREESBORO, TENN. — Following the refusal of the city to ratify at a recent election the contract made with the Davis-Elam Electric Light Company for a ten-year franchise, the Murfreesboro Light & Power Company has begun plans to erect a plant. George Beesley, John M. Butler and others are the incorporators.

NEWPORT, TENN.—The city will install a lighting system to cost $5,000. Bonds have just been sold for that purpose.

NIOTA, TENN.—The Niota Water Company plans to install an electric lighting plant.

BIRMINGHAM, ALA. — The Southern States Electric Company has been organized with capitalization of $4,000 by W. C. Mitchell, F. H. Chamberlain and others.

DECATUR, ALA.—The Alabama Power Company will spend $10,000 in the enlargement of their plant in the Decaturs. The work on the enlargement will commence within the next 30 days. The plant at this time has a capacity of 750 horsepower, which will be increased to 1,000 horsepower.

NEW DECATUR, ALA.—Plans have been prepared for a municipal electric lighting plant. The City Council has already decided to erect the plant.

NEW DECATUR, ALA.—It is reported that the Louisville & Nashville Railroad Company will install electric drive in its shops in this city. The Alabama Power Company will furnish the energy.

OPELIKA, ALA.—An ornamental lighting system is being proposed for main streets in this city.

ARGENTA, ARK.—The city is planning to purchase additional street lighting equipment.

CRANE, ARK.—Residents here contemplate building a dam on Crane Creek and building an electric lighting plant.

TUCKERMAN, ARK. — The Citizens' Light & Power Company will build an electric lighting and power plant at this place.

CHECOTAH, OKLA.—The Checotah Water, Light & Ice Company, is planning to install a natural-gas engine to operate 75-kilowatt generator, belt-driven; pole-line equipment to change 3.5 miles of present line from 2,300 to 6,600 volts, with proper transformers to give from 100 to 150 horsepower at the end of the line, where power is used to pump city water.

BURLINGTON, TEX.—H. Henderson has closed a contract with this city for the erection of an electric lighting plant. The generating equipment has been ordered and work on the installation will begin in the near future.

TEXAS CITY, TEX.—The City Commissioners are planning to install 31 additional electric lamps. If satisfactory arrangements can be made with the light company, bids will be immediately asked for the installation of the lamps.

WESTERN STATES.

SHUMWAY, ARIZ.—R. C. Smith has applied for a certificate of convenience and necessity, proposing to install a power plant at Shumway to serve the towns of Shumway, Snowflake and Taylor.

OGDEN, UTAH.—The construction of a new electric line between Utah, Hot Springs and Brigham City will be the principal improvement work taken up by the Ogden, Logan & Idaho Railway Company for the coming summer, according to an announcement by P. D. Kline, general manager. It is planned to complete the work and have the new line in operation by August 1.

PROVO, UTAH.—Application has been filed for ten cubic feet of water per second from the north and south branches of the North Fork Creek in Utah County for power purposes by John R. Stewart, of Provo, Utah. The application sets forth that a dam and pipe line and water power plant will be installed for the purpose of supplying electrical energy for lighting and power purposes in Wasatch County.

RENO, NEV.—The City Council has decided to have an electrolier lighting system installed by the Reno Power, Light & Water Company.

BANCROFT, IDAHO.—The proposition of constructing a municipal power plant is before the City Council, and it is reported a bond issue of $30,000 to provide funds for construction will be voted on at an early date.

HAILEY, IDAHO.—The City Council is negotiating with the Rockwell-White Electric Company and the Hailey Electric Light & Power Company for a new lighting contract which will require the immediate installation of a new lighting system costing about $7,000.

JULIAETTA, IDAHO.—Fred C. Holbrook of Culdesac, Idaho, has purchased the Juliaetta electric lighting plant and, according to reports, will make improvements to the plant and extensions to the local lines at an early date.

POCATELLO, IDAHO.—It is reported the City Council plans the installation of approximately 355 post lights, with single globe at the top, acorn shape. An ordinance providing for the improvement has passed its initial reading in the Council.

CENTRALIA, WASH.—The city is negotiating with the North Coast Power Company for the purchase of the company's electric equipment and business in Centralia. As an initial step, the city has requested the North Coast Power Company to set a price on its equipment and local business. At the present time practically all of the power company's transmission lines in the city are strung on poles belonging to the city.

PORT ANGELES, WASH.—The City Council will shortly call for bids for 80 light meters to fill the requirements for the next 12 months. The Council will also receive bids for a new contract to supply the city with electrical equipment as it is needed.

SEATTLE, WASH. — The Municipal Lighting Department, under the direction of Superintendent of Lighting J. D. Ross, has prepared plans for the construction of a 13,000-horsepower additional unit to the Lake Union steam auxiliary plant in Seattle. Cost of the unit, including machinery, is estimated at $250,000. The structure proper will be of reinforced concrete construction, and will be located north of the present structure. City Architect Daniel Huntington, has been commissioned to prepare plans for the building, which will cost about $20,000. Plans for the machinery installation will be prepared under the supervision of Superintendent Ross.

SPOKANE, WASH.—Plans for the installation of an ornamental lighting system on Sprague Avenue, from Bernard to Madison Street, to cost about $48,000, have been completed by Morton MacCartney, City Engineer. Reported bids for materials and installation of same will be called for at an early date.

SPOKANE, WASH.—Harry A. Flood, president of Merchants Central Heating Company of Spokane, which has under construction a central heating plant to supply business houses in Spokane with heat, reports his company will enter the local electric field and at this time is signing contracts calling for delivery of power about September 1. According to President Flood, the company has expended $275,000 for apparatus and construction to date. The total investment of the company in Spokane will approximate $1,000,000. The company will furnish meters for both steam and electric consumption without cost or deposit by the consumer. Free lamp renewals are provided for carbon lamps, and tungsten and nitrogen lamps of the latest type will be supplied at nominal prices. About 70 carloads of electrical equipment will be installed in the plant. In addition to the generating equipment, the company's service will be safeguarded by a large storage battery. The company's building is five stories high, 100 by 142 feet, of reinforced concrete, brick and steel.

MARSHFIELD, ORE. — The auxiliary plant of the Oregon Power Company at the Porter Mill was recently damaged by fire to the extent of about $4,000.

PORTLAND, ORE.—City Attorney La Roche has been instructed to prepare an ordinance requiring the replacement of the present overhead system of electric light and telephone lines in the Central East Side with underground lines. It has been suggested that the Pacific Telephone & Telegraph Company, the Home Telephone Company, the Portland Railway, Light & Power Company, and the Northwestern Electric Company, lay their wires and cables in common conduits, thereby reducing the cost of making the improvement.

BAKERSFIELD, CAL.—The County Supervisors have been petitioned to call an election for the organization of a public lighting district at McFarland.

BAKERSFIELD, CAL.—Plans are under consideration here for the installation of a lighting system similar to the electrolier system recently installed at Fresno.

CHICO, CAL.—The Pacific Gas & Electric Company is preparing to extend its service from De Sabla to the Paradise district.

LOS ANGELES, CAL.—The Board of Public Works has instructed a permit to be issued for the erection by the water department of a municipal power plant at St. John and Holly Streets. The building will be a three-story, concrete structure to cost about $60,000.

MERCED, CAL.—Voters at Atwater have submitted a petition to the County Board of Supervisors for the calling of an election for the formation of a lighting district.

POMONA, CAL.—Plans and specifications are being prepared for the proposed lighting system which Lincoln Park tract property owners have asked the Council to have installed. There will be 115 lamp posts in the proposed district.

RIVERSIDE, CAL.—The Southern Sierras Power Company has authorized the extension of its distributing system from Glenavon station north on Tyrolite Street to Mission Boulevard and one-half mile east on Mission Boulevard.

SAN BERNARDINO, CAL.—It is probable that the Santa Fe railroad will erect a private power plant in its local yards to supply power for its properties here.

YREKA, CAL.—The California-Oregon Power Company has secured a ten-year contract to supply power for the dredging operations of the Yukon Gold Company near Carrville, and is preparing to extend its service into Trinity County. The new power line will be built into Trinity by way of Lamoine. Construction work will be started soon and the line will be completed by next fall.

CORDOVA, ALASKA.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., William M. Smith, acting chief of bureau, will receive bids until April 22, for the construction of two 300-foot steel towers at the radio station near Cordova.

Proposals

MOTOR-GENERATOR SET.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 22, for furnishing one 60-kilowatt three-machine motor-generator set and switchboard, at the naval station, New Orleans, La. Specifications, No. 3056, may be obtained on application to the Bureau of Yards and Docks or to the industrial manager of the naval station, New Orleans.

CONDUIT AND WIRING SYSTEM.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until April 20, for a conduit and wiring system, lighting fixtures, etc., in the United States postoffice, Martinsburg, W. Va. Drawings and specifications may be obtained on application to the custodian of the site at Martinsburg or to the Supervising Architect, Washington.

ELECTRIC LIGHTING EQUIPMENT.—Sealed proposals will be received by the South Park Commissioners, Fifty-seventh Street and Cottage Grove Avenue, Chicago, Ill., until April 12, for furnishing and delivering into the substation in Grant Park, electrical apparatus required for the production of lighting service for Grant Park west of the Illinois Central Railroad and north of Jackson Street. J. F. Neil, secretary of the South Park Commissioners.

ELECTRIC FREIGHT ELEVATOR.—The Port Commission, Seattle, Wash., will receive bids until April 12 for the construction of an electric freight elevator in the two-story frame Spokane Street transit shed, plans and specifications of which are on file in the office of the Port Commission. Bidders are invited to submit alternative bids upon designs of their own, each bid to be accompanied by a certified check, payable to the Port Commission for not less than 5 per cent of the amount bid. C. E. Remsberg, Secretary.

ELECTRICAL SUPPLIES.—Bids will be received at the Bureau of Supplies and Accounts, United States Navy Department, Washington, D. C., for furnishing supplies at the following naval stations: Schedule 9439, Puget Sound, Wash., six motors; Schedule 9444, Philadelphia, Pa., 1,631 feet of three-conductor cable; Schedule 9445, Washington, D. C., three 35-kilowatt, oil-cooled transformers; Schedule 9445, Newport, R. I., 50,000 feet of two-conductor cable; Schedule 9452, Boston, Mass., 2,080 transmitting condensers and miscellaneous antenna wire; Schedule 9456, Mare Island, Cal., nine 0.25-horsepower ventilating sets. Bidders desiring to submit proposals should make application immediately for schedules to the Bureau, or to the Purchasing Office nearest to navy yard where delivery is to be made.

Financial Notes

Cleveland Telephone Company has increased its capital stock from $4,000,000 to $6,000,000.

The annual meeting of the General Electric Company will be held in Schenectady, N. Y., on May 9. Books close April 8 and reopen May 10.

General Gas & Electric Company has retired its three-year 6-per-cent secured notes, maturing April 1, 1918, and arrangements have been completed to pay off at maturity the three-year six-per-cent collateral notes maturing April 1, 1916.

Public Service Company of Northern Illinois has sold to N. W. Halsey & Company, Russell, Brewster & Company, Lee, Higginson & Company, and the Illinois Trust & Savings Bank $1,705,000 first and refunding-mortgage five-per-cent gold bonds.

Stockholders of American Power & Light Company subscribed to more than 85 per cent of the $6,984,300 six-per-cent 100-year gold debentures offered in the ration of 50 per cent of their stockholdings at 93, thus leaving less than 15 per cent to be taken by the underwriters.

The North Coast Power Company, maintaining head offices in Vancouver, Wash., formerly known as the Washington-Oregon Corporation, recently filed with the County Auditor at Chehalis, Wash., two mortgages, one in favor of the Germantown Trust Company for $917,000 and one in favor of the Commercial Trust Company for $675,000, both instruments securing bond issues of similar amounts. The mortgages cover all of the company's holdings in Washington and Oregon.

Pacific Gas & Electric Company has paid out of current funds $981,000 Oakland Gas Light & Heating Company five-per-cent first-mortgage bonds. The bonds were issued March 16, 1891. Pacific Gas & Electric will not at present make any capital issues against this capital expenditure. The retirement of these bonds leaves the California Gas & Electric general-mortgage and collateral-trust five-per-cent bonds a first lien on all the Pacific Gas & Electric properties in Alameda County, these properties being estimated to be worth $20,000,000 and the bonds outstanding under this mortgage being $4,517,000. As the $20,000,000 Califor-

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

	Mar. 27	Mar. 20
American Tel. & Tel. (New York)	130¼	129½
Commonwealth Edison (Chicago)	146	143
Edison Electric Illuminating (Boston)	246½	248½
Electric Storage Battery common (Philadelphia)	61⅞	64
Electric Storage Battery preferred (Philadelphia)	61⅞	64
General Electric (New York)	167	169½
Kings County Electric (New York)	129	129
Massachusetts Electric common (Boston)	8	7
Massachusetts Electric preferred (Boston)	35½	37
National Carbon common (Chicago)	.....	183
National Carbon preferred (Chicago)	.....	.....
New England Telephone (Boston)	137½	136
Philadelphia Electric (Philadelphia)	27⅝	27⅝
Postal Telegraph and Cables common (New York)	78	78
Postal Telegraph and Cables preferred (New York)	67½	67
Western Union (New York)	89½	91
Westinghouse common (New York)	65¾	68½
Westinghouse preferred (New York)	75	77

nia Gas & Electric unifying and refunding five-per-cent bonds are a first lien on all properties of the company outside San Francisco, they now have a secondary equity of more than $15,000,000 in the Alameda County properties alone.

Dividends.

	Term	Rate	Payable
Am. Pw. & Lt., pf.	Q	1.5 %	Apr. 1
Am. Pub. Service, pf.	Q	1.75 %	Apr. 1
Am. Tel. & Tel.	Q	2 %	Apr. 15
Ark. Lt. & Pw., pf.	Q	1.75 %	Apr. 1
Cen. & So. Am. Teleg.	Q	1.5 %	Apr. 8
Cin., Newport & Cov., pf.	Q	1.125%	Apr. 15
Cin., Newport & Cov., com.	Q	1.5 %	Apr. 15
Colo. Spgs. Lt., Ht. & Pow., pf.	Q	1.5 %	Mar. 31
Detroit Edison	Q	2 %	Apr. 15
Duq. Lt., pf.	Q	1.75 %	May 1
Elmira Water, Lt. & R. R., 7% pf.	Q	1.75 %	Mar. 31
Elmira Water, Lt. & R. R., 5% pf.	Q	1.25 %	Mar. 31
Gen. Gas & Elec., pf.	Q	1.75 %	Apr. 1
Harrisburg Lt. & Pw., pf.	Q	1.5 %	Mar. 31
Internat'l Trac., 7% pf.	Q	1.75 %	Apr. 1
Internat'l Trac., 4% pf.	Q	1 %	Apr. 1
Kellogg Sw. & Sup., st'k.	—	50 %	
Kellogg Sw. & Sup.	Q	2 %	Apr. 29
Manchester T., L. & P.	Q	$2	Apr. 15
Mexican Teleg.	Q	2.5 %	Apr. 15
N. E. Tel. & Tel.	Q	$1.75	Mar. 31
New Orleans Ry. & Lt. pf.	Q	1.25 %	Mar. 31
Pac. Tel. & Tel., pf.	Q	1.5 %	Apr. 15
Porto Rico Rys., pf.	Q	1.75 %	Apr. 1
Pub. Serv. Corp. of N. J.	Q	1.75 %	Mar. 31
Rep. Ry. & Lt., pf.	Q	1.75 %	Apr. 15
So. Cal. Edison, pf.	Q	1.5 %	Apr. 15
Tex. Pw. & Lt., pf.	Q	1.75 %	Apr. 1
Va. Ry. & Pw., com.	S	1.5 %	Apr. 20
United Gas & Elec. Corp., first pf.	Q	1.75 %	Apr. 1
Utah Pw. & Lt., pf.	Q	1.75 %	Apr. 1
Wash. Water Pw.	Q	$1.25	Apr. 1
W. Kootenay Pw.	—	$1.66⅔	Apr. 1
W. Kootenay Pw., pf.	Q	1.75 %	Apr. 1
West. E. & M.	Q	1.5 %	Apr. 29
West. E. & M., pf.	Q	1.75 %	Apr. 15

Reports of Earnings.

MONTANA POWER.

The report of the Montana Power Company for the year ended December 31, 1915, compares as follows:

	1915	1914
Gross	$4,359,408	$3,778,285
Net after taxes	3,167,504	2,639,239
Surplus after charges	1,978,342	1,575,625
Reserve for depreciation	300,000	
Surplus	1,678,342	1,575,625
Preferred dividends	677,026	677,026
Surplus	*1,001,316	898,599
Common dividends	604,283	536,636
Surplus	397,033	361,963

*Equal to 3.72 per cent earned on $26,907,500 common stock against 3.35 per cent on $26,831,800 stock previous year.

LOUISVILLE GAS & ELECTRIC COMPANY.

Net earnings for the year ended February 29, 1916, were 26.7 per cent greater than for the previous year. The increase in gross for this period was 12.2 per cent. Comparative figures are reported as follows:

	1916.	1915.
Gross earnings	$2,284,739	$2,035,504
Net earnings	1,331,303	1,050,277

ELECTRIC PROPERTIES.

The Electric Properties Corporation and Westinghouse, Church, Kerr & Company report for the year ended December 31, 1915, consolidate income account as follows:

	1915	1914
Income from operations	$785,802	$665,368
Operation, administration and general expenses	345,360	363,594
Bond interest	24,000	24,000
Surplus	416,442	277,774
Previous surplus	70,155	57,463
Preferred dividend	235,212	196,000
Capital adjustment	223,960	
Depreciation of securities		69,073
Surplus	475,345	70,155

SOUTHERN BELL TELEPHONE.

The Southern Bell Telephone Company reports for the year ended December 31, 1915, compared as follows:

	1915	1914
Operating revenue	$6,712,745	$6,598,878
Expenses and taxes	4,959,675	4,744,760
Operating income	1,753,070	1,854,118
Other income	866,756	893,304
Total income	2,619,826	2,747,422
Charges	1,042,342	1,104,617
Surplus	1,577,484	1,642,805
Dividends	1,284,000	1,284,000
Surplus	293,484	358,805
Miscellaneous deductions	16,845	38,591
Surplus	276,639	320,214

New Publications

ELECTROLYSIS MITIGATION.—Technologic Papers Nos. 54 and 55 of the Bureau of Standards constitute special studies in electrolysis mitigation by Burton McCollum, G. H. Ahlborn and K. H. Logan. The first deals with conditions in Springfield, O., and the second with Elyria, O.

MAGNETIC OBSERVATIONS.—The United States Coast and Geodetic Survey has published the "Results of Observations made at the Magnetic Observatory near Honolulu, 1913 and 1914," by Daniel L. Hazard. Hourly values are given of the components of the earth's magnetic field, with a record of earthquakes and magnetic storms.

METRIC SYSTEM.—At the request of the Secretary of the Treasury a report on the use of the Metric System in Export Trade was prepared by Director S. W. Stratton, of the United States Bureau of Standards. This report was submitted at the last meeting of the International High Commission on Uniformity of Laws on December 1 and was considered so complete and of such a useful character that Senator Fletcher recommended it being issued as a Senate Document. This has been done, and the document, printed in a booklet consisting of 80 pages, should be of intense interest to every manufacturer of electrical supplies, machinery, and machine tools who is in touch or desires to get in touch with foreign markets.

Foreign Trade Opportunities

[Addresses may be obtained from the Bureau of Foreign and Domestic Commerce, Washington, D.C., or its offices at Boston, New York, Atlanta, Chicago, St. Louis, New Orleans, Seattle and San Francisco. Write on separate sheet for each item and give file number.]

NO. 20360. INCANDESCENT ELECTRIC LAMPS.—An American consular officer in France reports that a firm in his district desires to represent American manufacturers of incandescent electric lamps.

NO. 20385. COPPER WIRE AND INSULATING MATERIAL.—An American consular officer in Norway reports that a firm in his district desires to receive quotations on copper wire and insulating material. Correspondence may be in English. Reference is given.

NO. 20421. ELECTRIC LAMPS.—A firm in England writes that it desires to communicate with American manufacturers of electric lamps.

NO. 20435. INSULATING MATERIALS.—A firm in England writes that it desires to purchase insulating materials, such as press-spahn, varnished cambric, and vulcanized fiber.

NO. 20437. MICA.—A commercial agent of the Bureau reports that a firm in Brazil desires to communicate with American importers of mica.

NO. 20464. MACHINERY.—A firm in Spain informs an American consular officer that it desires to purchase steam and water turbines; gas, gasoline, and crude-oil motors; electric machinery of all kinds, including copper and aluminum cables, wires, meters, etc.; and pumps of all kinds. References are given. Correspondence may be in English.

New Incorporations

AKRON, O.—U. N. D. Electric Company. Capital, $15,000. Incorporators: F. A. Dussel, H. F. Uhl and others.

DAYTON, O.—Dayton Storage Battery Company. Capital, $10,000. Incorporators: R. M. Robeson, C. A. Lesh and others.

EAST CLEVELAND, O. — Windemere Electrical Construction & Fixture Company. Capital, $6,500. Incorporators: A. C. Day, A. L. Keifer, G. A. Metzger and others.

ALBANY, N. Y.—E. H. Bocian Company. Capital, $5,000. Electrical contracting. Incorporators: E. H. Bocian, J. J. O'Connor and E. J. O'Connell.

NEW YORK, N. Y.—Triangle Conduit Company. Capital, $30,000. Manufacture conduit and appliances. Incorporators: F. W. Russell, Brooklyn; J. M. Edelson and G. S. Wittson, New York.

NEW YORK, N. Y.—Wappler Electric Company. Capital, $750,000. Manufacture X-ray and high-frequency machines. Incorporators: Kurt Stoye and T. F. J. Dermody, New York; G. Zimmerman, Brooklyn.

Electrical Patents Issued March 21, 1916

Prepared by Thomas Howe, Patent Attorney, 2 Rector Street, New York, N. Y.

1,175,954. Process of Making Storage-Battery Electrodes. H. C. Hubbell, Newark, N. J. Alternate layers of different metals are electro deposited and one of metals dissolved out.

1,175,976. Time-Controlling Mechanism for Electric Thermostats. A. P. Myer, assignor to Minneapolis Heat Regulator Co., Minneapolis, Minn. Details of device having clock-controlled shiftable posts.

1,175,977. Cooling System for Electric Motors. J. W. Nolan, assignor to Motor Cooling Apparatus Co. of Rhode Island, Pawtucket, R. I. Air circulation.

1,176,018. Furnace. T. F. Baily and F. T. Cope, assignors to The Electric Furnace Co., Alliance, O. Structural details of resistance-type electric furnace.

1,176,034. Electric Cut-Out. J. F. Conrad, Nanty Clo, Pa. Trolley-wire circuit-breaker.

1,176,035. Electric System. J. L. Creveling, assignor to Safety Car Heating & Lighting Co., Jersey City, N. J. Regulation of storage-battery car-lighting system.

1,176,036. Electric Brake for Automobiles. D. M. Dailey, Gary, Ind. Electromagnetically operated brake mechanism.

1,176,037. Journal-Bearing for Electric Machines. C. L. Daun, Saginaw, Mich. Bushing structure.

1,176,045. Telephone Prepay-Box. F. L. Fisher, assignor to J. H. Ware, Chicago, Ill. Details of coin-controlled circuit connections.

1,176,057. Automatic Signaling, Door-Closing and Operating System for Elevators. B. Heinrich, San Francisco, Cal. Circuit arrangements.

1,176,102. Means for Operating Switch Mechanism. R. A. Schoenberg, assignor to I. D. Rosenheim, New York, N. Y. Lamp-socket switch operated by moving bulb in and out.

1,176,105. Separator. H. R. Swartley, Jr., assignor to The New Departure Mfg. Co., Bristol, Conn. For electrolytic cells.

1,176,111. Collapsible Metal Pole. O. Valenne, New York, N. Y. Sectional formation; for supporting conductors.

1,176,119. Railway Signal and Stopping Mechanism. F. C. Williams, assignor to The Safety Block Signal Co., Delaware. Semaphore circuits and gearing in block system.

1,176,137. Insulator-Bracket. C. G. Ette, assignor to St. Louis Malleable Casting Co., St. Louis, Mo. Pin and mounting of malleable iron.

1,176,147, 1,176,148 and 1,176,149. Telegraphy. E. Keen, assignor to Telegravure Co., New York, N. Y. First patent: sending apparatus for transmitting pictures. Second patent: method of transmitting pictures. Third patent: modification.

1,176,178. Switching Device. W. F. Straub, assignor to Electric Time Recorder Co., Chicago, Ill. Special snap-switch.

1,176,201. Direction-Indicator. E. Cerf and F. Jordan, San Francisco, Cal. For automobiles; socket at one end for lamp within adjustable, tubular structure.

1,176,202. Circuit-Controlling Apparatus. H. W. Cheney, assignor to Allis-Chalmers Mfg. Co., Milwaukee, Wis. Electromagnetically controlled main switch, with indicator.

1,176,203. Lamp-Socket Support. G. W. Comer, Chicago, Ill. Adjustable arm with clamp for securing to head of bed, etc.

1,176,217. Electric Cooking Range. A. H.

Happe and W. J. Keep, assignors to The Michigan Stove Co., Detroit, Mich. Has hinged top and is easily kept clean.

1,176,231. Resistance-Box. F. W. Magin, assignor to Independent Electric Mfg. Co., Milwaukee, Wis. Has screened openings permitting ventilation but preventing molten metal from coming out.

1,176,234. Cab Block-Signaling System. T. H. Millington, assignor to J. A. Cameron, Chicago, Ill. Signals visible in engineer's cab.

1,176,235. Process of Making Lamp Structures. C. Moru, assignor to The Badger Brass Mfg. Co., Kenosha, Wis. Manner of making head-light body, reflector, etc.

1,176,260. Automatic Telephone System. C. S. Winston, assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Structure and arrangement of selector.

1,176,269. Telephone-Repeater. A. H. Blessing, assignor to Automatic Electric Co., Chicago, Ill. Automatic system has impulse repeater in trunk line.

1,176,282. Wireless Signaling. R. A. Fessenden, assignor to S. M. Kinter, Pittsburgh, Pa., and H. M. Barrett, Bloomfield, N. J. Receiving apparatus.

1,176,288. Insulating Splice-Cover. J. B. Hamilton, Hoboken, N. J. Elastic cap.

1,176,316. High and Low-Pressure Continuous-Current System. W. J. Rickets, assignor to A. Graham & Co., and said W. J. Rickets, Brockley, London, Eng. Battery-charging arrangements.

1,176,320. Transmitting Apparatus for Wireless Telegraphy. L. Rouzet, Levallois-Perret, France. Has specially tuned charging circuit.

1,176,333. Insulator-Pin. J. Baker, Battle Creek, Iowa. Stamped from a single piece of semi-circular tubing.

1,176,339. Telephone-Call-Registering Device. T. J. Byrum, Chicago, Ill., assignor of one-half to J. T. Fossberg, Chicago, Ill. Structural details.

1,176,357. Automatic Train-Stop Device. J. H. Forssberg, Stephenson, Mich. Motor operating valve on one vehicle operated by dynamo on approaching vehicle when in connection with same track conductor.

1,176,362. Thermoelectric Thermometer. G. Gollmer, assignor to Siemens & Halske, A. G. Berlin, Germany. Structure comprising thermoelectric couple.

1,176,373. System of Supplying Electrical Energy on Special Tariffs. H. Landis, Zug, Switzerland. Control of meter gearing for multiple rates.

1,176,374. Electric-Lighted Level. E. G. Laplante, Marlboro, Mass. Has special arrangement of battery and lamp.

1,176,377. Gear-Shift for an Electric Motor. B. M. Leece, assignor to the Leece-Neville Co., Cleveland, O. Interlocked with control of motor circuit.

1,176,390. Electromagnetically Controlled Irrigating Headgate. C. E. Mercer, Denver, Colo. Electrically controlled lock.

1,176,396. Centrifugally Regulated Power Transmission System. W. Morrisson, Chicago, Ill. Dynamoelectric clutch.

1,176,413. Terminal for Electric Wires. J. M. White, Philadelphia, Pa. Bent plate structure for receiving bared end of insulated wire.

1,176,420. Electric Soldering Machine. A. A. Bacon, assignor to Standard Optical Co., Geneva, N. Y. Parts to be welded heated by resistance method to temperature below welding.

1,176,421 and 1,176,422. Magnetic Device. C. E. Beach, assignor to G. O. Knapp, New York, N. Y. First patent: anomalous magnet and armature. Second patent: modification.

1,176,440. Contact Device for Electric Traction Systems. H. S. Farquhar, Wayne, Pa. Third-rail shoe held in contact mechanically and by magnetic attraction.

1,176,459. Lighting-Fixture. W. R. Kahns, assignor to J. H. White Mfg. Co., Brooklyn, N. Y. Shade at tip end of bulb supported from socket.

1,176,460. Fire-Detector Apparatus. C. H. Kayser and W. H. Hampton, assignors to Ideal Fire Detector Co., Newark, N. J. Thermopneumatically controlled contacts.

1,176,466. Flicker Attachment for Photometers. E. F. Kingsbury, assignor to United Gas Improvement Co., Philadelphia, Pa. For equality-of-brightness photometers.

1,176,467 and 1,176,468. Flash-Light-Battery Container. H. M. Koretzky, New York, N. Y. First patent: adapted to be collapsed flat when empty. Second patent: modification.

1,176,470. Sender. J. A. Kropp, assignor to Western Electric Co., New York, N. Y. Mechanism of impulse call-device.

1,176,474. Magnetizer. C. C. McDonald, Chenoa, Ill. Arrangement of electro for forming permanent magnets.

1,176,475. Lighting Means for Auditoriums and Other Places. F. G. McPerson, assignor to Shado-Lite Mfg. Co., Beaver Falls, Pa. Arrangement of lamps and reflectors therefor in elongated opaque hood. (See cut.)

1,176,476. Ignition Dynamo. C. T. Mason, assignor to Splitdorf Electrical Co., Newark, N. J. Combination of dynamo and battery with common induction coil.

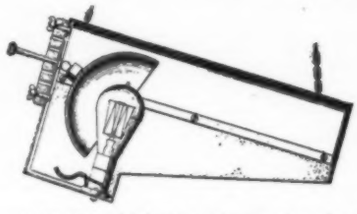
1,176,499. Fire Alarm Box. E. Tokarski, Pittsburgh, Pa. Details of call box.

1,176,502. Igniter Mechanism for Internal Combustion Engines. H. R. Van Deventer, assignor to Splitdorf Electrical Co. Combination of magneto and make-and-break igniter.

1,176,515. Electrcial Socket and Plug. C. H. Bissell and E. G. Smith, assignors to Crouse-Hinds Co., Syracuse, N. Y. Details of contacts, insulation, etc.

1,176,521. Burglar-Alarm. J. Chankin, New York, N. Y. Structure of tubular circuit closer.

1,176,522. Telephone System and Individual Transmitter Therefor. C. L. Chrisholm, assignor to Chrisholm Transmitter & Telephone Instruments Co., Marysville,



No. 1,176,475.—Lighting Means for Auditoriums and Other Places.

New Brunswick, Canada. Individual transmitter switched into circuit of instrument at will.

1,176,539. Indicating Device for Automobiles. A. E. Gaugh and J. Cawby, Lexington, Ky. Solenoid-operated direction-indicator.

1,176,540. Electrolytic Cell. A. E. Gibbs, assignor to Pennsylvania Salt Mfg. Co., Philadelphia, Pa. Circulation of electrolyte controlled to remove products of electrolysis from surface of cathode.

1,176,541. Process of Electrolysis. A. E. Gibbs, assignor to Pennsylvania Salt Mfg. Co. Related to above.

1,176,542. Motor Controller. M. M. Goldenstein, assignor to Cutler-Hammer Mfg. Co., Milwaukee, Wis. Driving units and their connection with driven units controlled from a station.

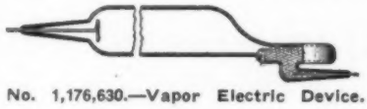
1,176,544. Protective Device. G. F. Gray, assignor to General Electric Co., Schenectady, N. Y. Spark-gap device for arresters, etc.

1,176,554. Electrical Connection. S. Herzig, New York, N. Y. Plug coupling.

1,176,559. Method of and Apparatus for Electrical Measurement. C. A. Hoxie, assignor to General Electric Co., Schenectady, N. Y. Method of measuring capacity and inductance by means of a bridge.

1,176,569. Contactor with Anti-Welding Device. M. K. Kjolseth, assignor to General Electric Co. Details of magnet-operated switch.

1,176,577. Sound-Transmitter. B. F. Lee,



No. 1,176,630.—Vapor Electric Device.

Schoolfield, Va. Incoming sound waves deflected outwardly, by cone on center of diaphragm and absorbed by felt lining.

1,176,583. Knife. T. J. McPhee, Spokane, Wash. For linemen.

1,176,584. Tool-Operating Machinery. J. F. Madgett, assignor to General Electric Co. Operating motor on horizontal arm turning on pedestal.

1,176,590. Protected Insulator. J. H. Mock, Jetmore, Kans. Enclosed split globe.

1,176,602. Metallic-Filament Electric Incandescent Lamp. H. C. G. Remane, assignor to General Electric Co. Filament support.

1,176,614. Welding Pressure Contact. A. M. Stanley, assignor to General Electric Co. Spot welding contact of tungsten.

1,176,616. Switch-Operating Mechanism. H. M. Stevens, assignor to General Electric Co. Lever mechanism for hand-operated switch.

1,176,618. Insulator. W. E. Swearingen, Montgomery City, Mo. Pin type; special wire securing means and protection from weather.

1,176,622. Electrical Attachment Plug. W. C. Tregoning, Cleveland, O. Wires are wedged against seats.

1,176,623. Spark-Gap Adjuster. L. Tronchon, assignor to Compagnie Generale Radiote Legraphique, Paris, France. Rotatable electrodes in frame which is deformable parallelogram.

1,176,625. Electric Brake. J. J. Tyson, Montgomery, Ala., assignor of one-half to J. Russell Tyson, Montgomery, Ala. Electromagnetically operated car brakes on multiple-unit principle.

1,176,629. Tree Insulator and Wire Supporter. W. H. Wallace, Roscommon, Mich. Holder and attacher for insulating tube.

1,176,630. Vapor Electric Device. E. Weintraub, assignor to General Electric Co. Contains tantalum chlorid and an anode superficially of platinum. (See cut.)

1,176,632. Electrical Machine. F. Werner, Hamilton, Ontario, Canada. Collector rings and short-circuiting device in collector type induction motor.

1,176,634. Time Element. A. Aichele, assignor to Aktiengesellschaft Brown Boveri and Cie, Baden, Switzerland. Electromagnetic device.

1,176,635. Push-Button Switch. J. M. S. Anderson, assignor to The Perkins Electric Switch Mfg. Co., Bridgeport, Conn. Details.

1,176,659. Attachment Plug. F. C. DeReamer, assignor to General Electric Co. Special structure having swiveled contact shell.

1,176,660. Electric Switch. F. C. DeReamer, assignor to General Electric Co. For mounting in end of handle.

1,176,661. Vapor Electric Device. P. K. Devers, assignor to General Electric Co. Method of operating device containing halogen compound.

1,176,668. System of Ship Propulsion. W. L. R. Emmet, assignor to General Electric Co. Arrangement for cooling secondary resistance of induction motor driving propeller.

1,176,698. Electric-Plant-Control Device. A. H. Brandon, assignor to B. Love, Jr., Toledo, O. Battery-charging arrangement.

1,176,715. Telephone-Exchange System. T. G. Martin, assignor to First Trust & Savings Bank, Chicago, Ill. Automatic.

1,176,716. Party-Line Automatic Telephone System. E. A. Mellinger, assignor to First Trust & Savings Bank. Special circuit arrangement.

1,176,725. Balanced Electrical Transmitter. E. H. Amet, Redondo Beach, Cal. Sensitiveness of variable resistance of microphone increased and automatically adjusted to temperature changes.

PATENTS EXPIRED.

The following United States electrical patents expired on March 28, 1916:

621,778. Electric-Lighting Gas-Burner. J. M. Auck, Philadelphia, Pa.

621,807. Insulating Compound. B. Ford, Johnstown, Pa.

621,827. System of Electrical Distribution. W. H. Knight, New York, N. Y.

621,848. Electric Railway. H. C. Reagan, Jr., Philadelphia, Pa.

621,854. Electric Hose-Signal System. H. Sargent, Cambridge, Mass.

621,855. Electric Arc Lamp. R. Schefbauer, Jersey City, N. J.

621,863. Printing Telegraph. S. J. Small, Seattle, Wash.

621,876. Electric Arc Lamp. E. P. Warner, Chicago, Ill.

621,907. Electrolytic Cell. H. H. Dow, Midland, Mich.

621,908. Porous Diaphragm for Electrolytic Cells and Method of Producing Same. H. H. Dow.

621,924. Means for Speed Reduction of Asynchronous Alternating Motors. K. E. F. Knauth, Charlottenburg, Germany.

621,963. Electric Action for Musical Instruments. W. B. Fleming, Detroit, Mich.

621,976. Overload Safety Device for Electric Circuits. L. G. Rowand, Camden, N. J.

621,984. Trolley-catcher. O. W. Whitehead, Dayton, O.

622,075. Protective Fuse. E. B. W. Reichel, Berlin, Germany.

622,078. Means for Generating Electricity from Machinery of Locomotives. H. F. Roach, St. Louis, Mo.

622,087. Filament for Incandescent Electric Lamps. C. H. Stearn, London, England.

622,116. Electric Switch. M. H. Caspari, New York, N. Y.

622,124. Secondary Battery. W. A. Crowdus, Chicago, Ill.

622,144. Electric Propulsion of Railroad Tramway or Other Similar Vehicles. J. J. Heilmann, Paris, France.

622,151. Electric Incandescent Lamp. C. Howard, London, England.

622,177. Electrical Knob. C. M. Brown, Newark, N. J.

622,186. Railway Advertising Apparatus. C. J. Feder, Paterson, N. J.

622,188. Keyless Switch Socket for Incandescent Lamps. M. Meyberg, Los Angeles, Cal.